Internal Report
DESY F41
HASYLAB 81/01
January 1981

OPTICAL PROPERTIES OF METALS I:
THE TRANSITION METALS, $0.1 \leq h\nu \leq 500$ eV[+]

Ti	V	Cr	Mn	Fe	Co	Ni
Zr	Nb	Mo		Ru	Rh	Pd
Hf	Ta	W	Re	Os	Ir	Pt

by

J.H. Weaver, C. Krafka
D.W. Lynch and E.E. Koch

OPTICAL PROPERTIES OF METALS I:
THE TRANSITION METALS, $0.1 \le h\nu \le 500$ eV[*]

Ti	V	Cr	Mn	Fe	Co	Ni
Zr	Nb	Mo		Ru	Rh	Pd
Hf	Ta	W	Re	Os	Ir	Pt

J.H. Weaver and C. Krafka
Synchrotron Radiation Center, University of Wisconsin[†]
Stoughton, Wisconsin 53589 USA

D.W. Lynch
Department of Physics, Iowa State University and Ames Laboratory USDOE[†]
Ames, Iowa 50011 USA

E.E. Koch
Hamburger Synchrotronstrahlungslabor HASYLAB, DESY
Hamburg, West Germany

---

[*] In volume II we consider the lanthanides plus Sc and Y, the actinides, the noble metals, and Al.

[†] Work supported in part by NSF DMR7821080 and DOE-OBES-W7405-Eng-82

ACKNOWLEDGEMENTS

The authors are grateful for the encouragement of colleagues and the excellent support of their home laboratories. The optical measurements shown herein associated with two of the authors (Weaver and Lynch) often reflect collaboration with C.G. Olson of the Ames Laboratory. In our own original optical studies, we profited from the fine support of the Ames Laboratory, USDOE, and the Synchrotron Radiation Center, University of Wisconsin-Madison. We are grateful to M.J. Arttus for her dedication in preparing this manuscript; to B. Kaufner and W. Knaut for their skillful drawings of the many figures; to K. Weaver for encouragement; to colleagues who provided the results of their optical studies, published and unpublished; and to D.J. Peterman for computer assistance.

TABLE OF CONTENTS

Page

Vorwort/Preface.. i

Acknowledgements... iii

List of Tables... 1

List of Figures.. 2

1. Introduction.. 7
   1.1 General Comments.. 7
   1.2 Definitions... 10
   1.3 Methods of Measurements and Errors.............................. 18
   1.4 Use and Misuse of the Data...................................... 24
   1.5 References.. 27

2. Optical Properties of the 3d Transition Metals...................... 31
   Ti.. 31
   V... 48
   Cr.. 60
   Mn.. 71
   Fe.. 78
   Co.. 88
   Ni.. 98

3. Optical Properties of the 4d Transition Metals...................... 112
   Zr.. 112
   Nb.. 130
   Mo.. 141
   Ru.. 155
   Rh.. 168
   Pd.. 179

4. Optical Properties of the 5d Transition Metals...................... 191
   Hf.. 191
   Ta.. 211
   W... 222
   Re.. 238
   Os.. 252
   Ir.. 262
   Pt.. 271

5. Bibliography.. 283

LIST OF TABLES

Page

Table 1. List of abbreviations used in the figures and tables.......... 30

Table 2. Ti - Summary of experimental studies.......................... 31

Table 3. V - Summary of experimental studies........................... 48

Table 4. Cr - Summary of experimental studies.......................... 60

Table 5. Mn - Summary of experimental studies.......................... 71

Table 6. Fe - Summary of experimental studies.......................... 78

Table 7. Co - Summary of experimental studies.......................... 88

Table 8. Ni - Summary of experimental studies.......................... 98

Table 9. Zr - Summary of experimental studies.......................... 112

Table 10. Nb - Summary of experimental studies......................... 130

Table 11. Mo - Summary of experimental studies......................... 141

Table 12. Ru - Summary of experimental studies......................... 155

Table 13. Rh - Summary of experimental studies......................... 168

Table 14. Pd - Summary of experimental studies......................... 179

Table 15. Hf - Summary of experimental studies......................... 191

Table 16. Ta - Summary of experimental studies......................... 211

Table 17. W - Summary of experimental studies.......................... 222

Table 18. Re - Summary of experimental studies......................... 238

Table 19. Os - Summary of experimental studies......................... 252

Table 20. Ir - Summary of experimental studies......................... 262

Table 21. Pt - Summary of experimental studies......................... 271

LIST OF FIGURES

Page

Fig. 1 Sketch of the reflectance of a free electron gas, its dielectric function, and its loss function ... 13

Fig. 2 Survey of available data for Ti ... 33

Fig. 3a Reflectivity of Ti ... 34

Fig. 3b Reflectivity of single crystal Ti for $\vec{E}\parallel\hat{c}$ and $\vec{E}\perp\hat{c}$ ... 35

Fig. 4a ε_1 for polycrystalline Ti ... 36

Fig. 4b ε_1 for single crystal Ti for $\vec{E}\parallel\hat{c}$ and $\vec{E}\perp\hat{c}$ ... 37

Fig. 5a ε_2 for polycrystalline Ti ... 38

Fig. 5b ε_2 for single crystal Ti for $\vec{E}\parallel\hat{c}$ and $\vec{E}\perp\hat{c}$ ... 39

Fig. 6 Absorption coefficient for Ti ... 40

Fig. 7 Survey of available data for V ... 50

Fig. 8 Reflectivity of V ... 51

Fig. 9 ε_1 for V ... 52

Fig. 10 ε_2 for V ... 53

Fig. 11 Absorption coefficient for V ... 54

Fig. 12 Survey of available data for Cr ... 62

Fig. 13 Reflectivity of Cr ... 63

Fig. 14 ε_1 for Cr ... 64

Fig. 15 ε_2 for Cr ... 65

Fig. 16 Absorption coefficient for Cr ... 66

Fig. 17 Survey of available data for Mn ... 72

Fig. 18 Reflectivity of Mn ... 73

Fig. 19 ε_1 for Mn ... 74

Fig. 20 ε_2 for Mn ... 75

Fig. 21 Absorption coefficient for Mn ... 76

LIST OF FIGURES (continued)

Page

Fig. 22 Survey of available data for Fe ... 79

Fig. 23 Reflectivity of Fe ... 80

Fig. 24 ε_1 for Fe ... 81

Fig. 25 ε_2 for Fe ... 82

Fig. 26 Absorption coefficient for Fe ... 83

Fig. 27 Survey of available data for Co ... 89

Fig. 28 Reflectivity for Co ... 90

Fig. 29 ε_1 for Co ... 91

Fig. 30 ε_2 for Co ... 92

Fig. 31 Absorption coefficient for Co ... 93

Fig. 32 Survey of available data for Ni ... 101

Fig. 33 Reflectivity of Ni ... 103

Fig. 34 Reflectivity of Ni for $0 \le h\nu \le 6$ eV ... 104

Fig. 35 ε_1 for Ni ... 105

Fig. 36 ε_2 for Ni ... 106

Fig. 37 Absorption coefficient for Ni ... 107

Fig. 38 Survey of available data for Zr ... 114

Fig. 39 Reflectivity of Zr ... 115

Fig. 40a ε_1 for polycrystalline Zr ... 116

Fig. 40b ε_1 for Zr for $\vec{E}\perp\hat{c}$, $0 \le h\nu \le 6$ eV ... 117

Fig. 41a ε_2 for polycrystalline Zr ... 118

Fig. 41b ε_2 for Zr for $\vec{E}\perp\hat{c}$, $0 \le h\nu \le 6$ eV ... 119

Fig. 42 Absorption coefficient for Zr ... 120

LIST OF FIGURES (continued)

Page

Fig. 43 Survey of available data for Nb 132

Fig. 44 Reflectivity of Nb 133

Fig. 45 ε_1 for Nb 134

Fig. 46 ε_2 for Nb 135

Fig. 47 Absorption coefficient for Nb 136

Fig. 48 Survey of available data for Mo 144

Fig. 49 Reflectivity for Mo 146

Fig. 50 ε_1 for Mo 147

Fig. 51 ε_2 for Mo 148

Fig. 52 Absorption coefficient for Mo 149

Fig. 53 Survey of available data for Ru 156

Fig. 54 Reflectivity of Ru 157

Fig. 55 ε_1 for Ru 158

Fig. 56 ε_2 for Ru 159

Fig. 57 Survey of available data for Rh 170

Fig. 58 Reflectivity for Rh 171

Fig. 59 ε_1 for Rh 172

Fig. 60 ε_2 for Rh 173

Fig. 61 Absorption coefficient for Rh 174

Fig. 62 Survey of available data for Pd 181

Fig. 63 Reflectivity of Pd 182

Fig. 64 Reflectivity of Pd for $0 \le h\nu \le 6$ eV 183

Fig. 65 ε_1 for Pd 184

Fig. 66 ε_2 for Pd 185

Fig. 67 Absorption coefficient for Pd 186

LIST OF FIGURES (continued)

Page

Fig. 68 Survey of available data for Hf 192

Fig. 69 Reflectivity of Hf 193

Fig. 70a ε_1 for Hf 194

Fig. 70b ε_1 for polycrystalline Hf 195

Fig. 71a ε_2 for Hf 196

Fig. 71b ε_2 for polycrystalline Hf 197

Fig. 72 Absorption coefficient for Hf 198

Fig. 73 Survey of available data for Ta 213

Fig. 74 Reflectivity of Ta 214

Fig. 75 ε_1 for Ta 215

Fig. 76 ε_2 for Ta 216

Fig. 77 Absorption coefficient for Ta 217

Fig. 78 Survey of available data for W 225

Fig. 79 Reflectivity of W 227

Fig. 80 Reflectivity of W for $0 \le h\nu \le 6$ eV 228

Fig. 81 ε_1 for W 229

Fig. 82 ε_2 for W 230

Fig. 83 Absorption coefficient for W 231

Fig. 84 Survey of available data for Re 239

Fig. 85 Reflectivity for Re 240

Fig. 86 ε_1 for Re 241

Fig. 87 ε_2 for Re 242

Fig. 88 Absorption coefficient for Re 243

LIST OF FIGURES (continued)

Page

Fig. 89 Survey of available data for Os........................... 253

Fig. 90 Reflectivity of polycrystalline Os........................ 254

Fig. 91 ε_1 for polycrystalline Os.................................. 255

Fig. 92 ε_2 for polycrystalline Os.................................. 256

Fig. 93 Absorption coefficient for Os............................ 257

Fig. 94 Survey of available data for Ir........................... 263

Fig. 95 Reflectivity of Ir.. 264

Fig. 96 ε_1 for Ir.. 265

Fig. 97 ε_2 for Ir.. 266

Fig. 98 Absorption coefficient for Ir............................ 267

Fig. 99 Survey of available data for Pt........................... 273

Fig. 100 Reflectivity of Pt.. 274

Fig. 101 Reflectivity of Pt for $0 \le h\nu \le 3$ eV...................... 275

Fig. 102 ε_1 for Pt.. 276

Fig. 103 ε_2 for Pt.. 277

Fig. 104 Absorption coefficient for Pt............................ 278

INTRODUCTION

We have collected in this volume data on the optical properties of the elemental transition metals Ti-Ni, Zr-Pd, and Hf-Pt. A companion volume to follow will consider the optical properties of the noble metals and aluminum, the lanthanides including Sc and Y, and the actinides. A third volume will contain information on the alkali metals, the alkaline earths, Zn, Cd, Hg, Ga, In, Tl, Sn, and Pb. In this way we will gather together for easy reference the optical properties of all the elemental metals as they are known currently, 1980.

In this data compilation we present tables summarizing the work that has been done for each element (techniques, sample preparation, spectral range, etc.). Figures for each element display the most frequently used optical quantities, i.e. the normal incidence reflectance or reflectivity, the real and imaginary parts of the frequency-dependent dielectric function, and the absorption coefficient. Tables of these quantities and the loss function are given for each element.

This data compilation covers the wavelength range $25\ \text{Å} \le \lambda \le 25\ \mu\text{m}$, i.e. the photon energy range $0.05 \le h\nu \le 500$ eV $[h\nu(\text{eV}) = 12398/\lambda(\text{Å})]$. Most of the published data fall between ~1 eV and ~6 eV, in the range where photomultiplier detectors and conventional laboratory sources are available. In the vacuum ultraviolet for $6 \le h\nu \le 30$ eV, synchrotron radiation sources, rare gas continua, and discrete line sources have been used to measure the reflectance at near-normal incidence. For photon energies of ~30-200 eV, the absorption coefficient has been measured with synchrotron radiation for most of the transition metals but rarely at higher energy. Unfortunately, we have found that there is not a complete set of data for many of the transition metals throughout the entire range. Data for wavelengths shorter than about 25 Å are quite sparse because of the difficulty of obtaining monochromatic radiation, particularly between 1 and 3 keV. Monochromator development programs now underway at many synchrotron radiation facilities around the world should improve the situation within the next few years.

The comparative tables and figures which describe the available data point out regions where reliable data are not available or where the present data are still insufficient or ambiguous. In many cases when we seek to provide a set of "most reliable" optical data, we have chosen to use our own data, accumulated for nearly all of the transition metals over the last ten years. The reader can readily compare those tabular results to the rest of the literature through perusal of the figures. The advantage of this format has been twofold: first, we have studied these metals over a wide spectral range (typically 0.1 to 30 eV) and therefore the tabulated optical constants represent a single study rather than a patchwork of many and, second, the results were available to us in a format which was quantitatively more reliable than could have been duplicated by extracting numbers from journal-sized figures. We hope that the reader will forgive our chauvinism; there are cases, of course, where the results of others are superior. Before using our tables, the reader should consult the Methods of Measurements and Errors section and that devoted to The Use and Misuse.

The data have been obtained from a number of sources. To supplement the references collected by the authors over the years, we have searched via computer the abstracts appearing in Physics Abstracts and

Chemistry Abstracts, the former from 1969 to present and the latter from 1970 to present. In addition we have solicited unpublished data from colleagues. We have omitted much of the data obtained in the 1950's and essentially all data obtained before 1950. We have generally excluded non-spectral optical data, e.g. values of the complex refractive index obtained ellipsometrically at the wavelengths of one or several spectral lines, and emissivity measurements at one wavelength. It is inevitable that we have overlooked some data or reference that we would like to have included. For such omissions we apologize.

The compilation has a large number of applications. For example, reliable optical constants are needed to design multiple-layer films for application in solar-energy-systems or reflecting optical elements. The data can be used to obtain spectral emissivities for measurements of the temperatures of hot transition metals. Of course, it can be used for a fundamental comparison between experimental optical properties and those calculated from first principles.

We begin with several definitions, then briefly discuss methods of measurement and the associated errors of each. Finally, before presenting the data in tabular and pictorial form, we offer several caveats about the use of the data.

DEFINITIONS

In a macroscopic view, the propagation of electromagnetic waves in an absorbing medium is governed by a frequency-dependent conductivity, $\sigma(\omega)$, and a frequency-dependent dielectric constant, $\varepsilon(\omega)$[1-6]. These usually are combined into a frequency-dependent complex dielectric function $\tilde{\varepsilon} = \varepsilon_1 + i\varepsilon_2$, or a frequency-dependent complex conductivity, $\tilde{\sigma} = \sigma_1 + i\sigma_2$, with

$$\tilde{\varepsilon}(\omega) = 1 + 4\pi i\tilde{\sigma}(\omega)/\omega \qquad (1)$$

and $\varepsilon_1 = \varepsilon$ and $\sigma_1 = \sigma$. Note that a metal, with its finite conductivity at $\omega = 0$, has $\varepsilon_2(\omega) \rightarrow \infty$ as $\omega \rightarrow 0$, but this causes no problems in the wave equation.*

For non-cubic materials, $\tilde{\sigma}$ and $\tilde{\varepsilon}$ will be tensors[7,8], but for all elemental metals which have been measured this tensor is diagonal in the crystallographic axis system, and there are no more than three independent components. One should be aware, however, that evaporated films of non-cubic metals may not always have isotropic optical properties, for there often is a preferred texture, with close-packed planes preferred. In the ensuing discussion we assume, for simplicity, an optically isotropic metal, either a cubic crystal or randomly-oriented grains in a polycrystalline film.

---

* The time-dependent Maxwell's equations are Fourier analyzed. In complex notation the time dependence of all fields is then either $\exp(i\omega t)$ or $\exp(-i\omega t)$. Either may be used and the resultant real parts of the fields, the measurables, are the same. The choice of sign does, however, affect the signs of the imaginary parts of the optical functions. We have used $\exp(-i\omega t)$ which leads to the positive sign on the imaginary parts of the complex quantities above. This choice is more consistent with the microscopic interpretation of optical properties based on quantum mechanics. The other choice of sign also is widely used, however.

Optical studies describe the response of matter to an applied electromagnetic field at optical frequencies ($\sim 10^{16}$ Hz). As discussed above, this is done through the frequency-dependent complex dielectric function, $\tilde{\varepsilon}(\omega) = \varepsilon_1 + i\varepsilon_2$ or, equivalently, the complex conductivity, $\tilde{\sigma}(\omega) = \sigma_1 + i\sigma_2$, which are used with Maxwell's equations, but which are descriptions of the material being studied. These are fundamental quantities, and can be calculated quantum mechanically from microscopic models of the solid. Either represents the elementary excitation spectrum, i.e., ε_2 (interband) or σ_1 (interband) provides a measure of interband absorption. ε_2 (interband) can be written as

$$\omega^2\varepsilon_2 = \frac{e^2\hbar^2}{3\pi m^2} \sum_{\#}\int_0^\infty d^3k|<f|p|i>|^2\ \delta(E_f(\bar{k})-E_i(\bar{k})-\hbar\omega), \qquad (2)$$

where the electric dipole approximation has been used for the electron-photon interaction Hamiltonian, $|i>$ and $|f>$ are the initial (occupied) and final (empty) states, and $\bar{k}$, the electron wave vector, has been conserved through direct transitions.

A complete calculation of ε_2 from first principles is difficult, but can be simplified by assuming that matrix elements are independent of $\bar{k}$, i.e. are constant throughout the Brillouin zone. Then

$$\omega^2\varepsilon_2 \propto \sum_{\#}\int_0^\infty d^3k\ \delta(E_f(\bar{k})-E_i(\bar{k})-\hbar\omega), \qquad (3)$$

which is termed the joint density of states (JDOS). The JDOS reflects the shape of the electronic energy bands, but obscures any information regarding transition probability variation.

Evaluations of equations (2) or (3) for the transition metals have shown that structures in the experimental ε_2 can arise from extended volumes of k-space, and the importance of critical points is diminished in transition metals. Further, it has been shown that volumes of k space which are removed from high-symmetry lines can be the source of interband structures.

The dielectric function for the transition metals also includes contributions from intraband absorption. The free-carrier or intraband (or free-electron or Drude) absorption is described by

$$\tilde{\epsilon}(\omega) = 1 - \frac{\omega_p^2}{\omega(\omega+i/\tau)} \qquad (4)$$

where ω_p is the free-electron plasma frequency and τ is the electronic relaxation time. The plasma frequency is defined by $\omega_p^2 = 4\pi Ne^2/m$, where N is the number of electrons of mass m per unit volume. For a free-electron gas with $\omega\tau >> 1$, the absorptivity reduces to $A = 2/\omega_p\tau$ which is small. In figure 1, the free electron dielectric function is shown qualitatively. At low energy, ϵ_2 is large and positive while ϵ_1 is large and negative. Both approach zero with increasing photon energy; ϵ_1 ultimately crosses zero at the plasma frequency and approaches unity at infinite frequency. In an experimental spectrum of the dielectric function for a real metal, the deviation from this simple behavior can be taken as an indication of interband absorption; see Fig. 1 for sketches of free carrier behavior.

For transition metals, where the d bands intersect the Fermi level, interband absorption begins at arbitrarily low energy, and it is impossible to separate the interband and intraband contributions completely. Nevertheless, it may be possible to fit the measured spectrum with a Drude-like spectrum over a limited energy range. The Drude parameters obtained in that way should not be taken too seriously. Nevertheless, they are often useful for separating approximately the low-energy interband and intraband contributions to $\tilde{\epsilon}(\omega)$ facilitating comparison of theory with experiment.

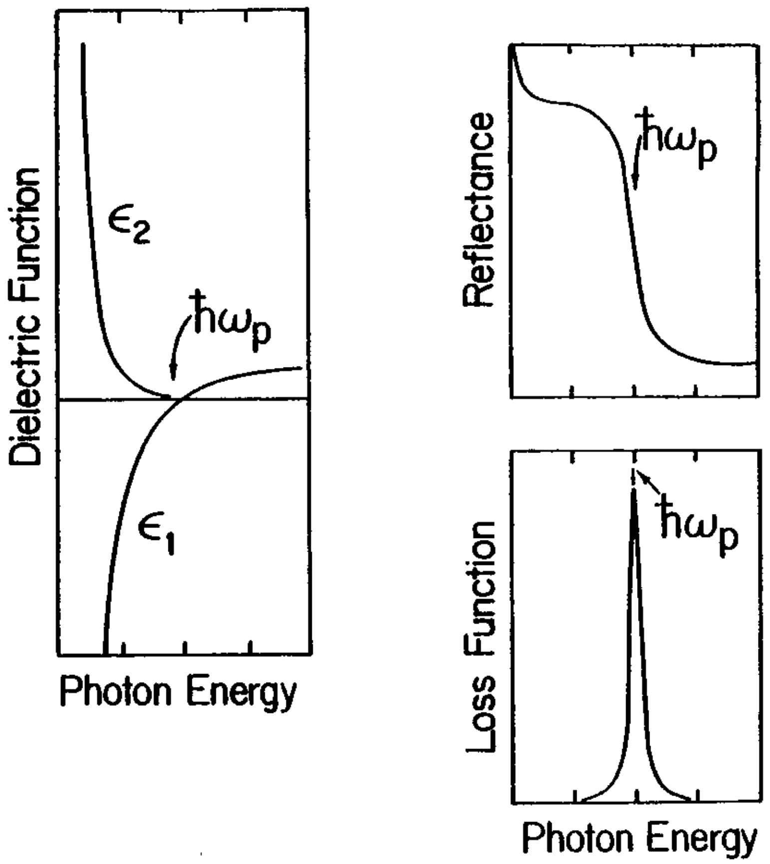

Fig. 1 Sketch of the reflectance of a free electron gas, its dielectric function, and its loss function.

The real and imaginary parts of the dielectric function are not completely independent. They are related in an integral-transform fashion by the so-called Kramers-Kronig or dispersion integrals:[2-5]

$$\varepsilon_1(\omega) - 1 = \pi^{-1} \; P \int_0^\infty \frac{\varepsilon_2(\omega') - \frac{4\omega\sigma(o)}{\omega'}}{\omega'^2 - \omega^2} \, \omega' d\omega' \tag{5}$$

$$\varepsilon_2(\omega) - \frac{4\pi\sigma(o)}{\omega} = \frac{-2\omega}{\pi} \; P \int_0^\infty \frac{\varepsilon_1(\omega') - 1}{\omega'^2 - \omega^2} \, d\omega' \tag{6}$$

where P denotes principal value. If a set of optical data such as $\varepsilon_1(\omega)$ and $\varepsilon_2(\omega)$ is self-consistent, it must satisfy the above relations, when suitable extrapolations to zero and infinity are appended to the data measured over some finite spectral range.

By letting $\omega \to \infty$, a limit in which we expect the electrons in the solid to behave as free electrons, we obtain the sum rule[2,5]

$$\int_0^\infty \omega\varepsilon_2(\omega) d\omega = 2\pi^2 \; \frac{Ne^2}{m} = \frac{\pi}{2} \, \omega_p^2 \tag{7}$$

which forms a very useful test of the data. This is equivalent to the f-sum rule of atomic physics. It states that the integral of ε_2 weighted by ω is proportional to N, the number density of electrons in the sample. By integrating to a finite upper limit, partial sum rules are obtained, but their use is somewhat restricted by assumptions necessary for their use.

There are several other sum rules[2,3] that are useful for testing data for consistency. These are

$$\int_0^\infty [\varepsilon_1(\omega) - 1] \, d\omega = -2\pi^2\sigma(o), \tag{8}$$

which relates the real part of the dielectric function to the d.c. conductivity, and

$$\int_0^\infty [n(\omega) - 1] d\omega = 0 \; , \tag{9}$$

which states that the average value of the refractive index is unity. These, and others[9-12], have been applied to optical data for aluminum and, to date, there are departures from self-consistency even when the best available data are used[13].

The boundary conditions on the electric and magnetic fields, implicit in Maxwell's equations[1-6], give values for the reflected and transmitted fields in terms of the dielectric function, $\tilde{\varepsilon}$, the angle of incidence, ϕ, and the state of polarization, s or p. If $\tilde{r}$ is the ratio of reflected electric field to incident electric field at a vacuum-solid interface, then[6]

$$\tilde{r} = \frac{\tilde{E}_r}{\tilde{E}_i} = (\tilde{g} - 1)/(\tilde{g} + 1) \tag{10}$$

with $\tilde{g} = \sqrt{\tilde{\varepsilon}} \cos \phi'$ for s-polarization

and $\tilde{g} = \cos \phi' / \sqrt{\tilde{\varepsilon}}$ for p-polarization,

in which $\sqrt{\tilde{\varepsilon}} \sin \phi' = \sin \phi$. The phase shift upon reflection, θ, is included in $\tilde{r}$ as $\tilde{r} = re^{i\theta}$. At this point it may be useful to introduce the complex index of refraction, defined* as

$$\tilde{N} = n + ik = \sqrt{\tilde{\varepsilon}} \; . \tag{11}$$

Then $\varepsilon_1 = n^2 - k^2$ and $2n^2 = (+\varepsilon_1 + \sqrt{\varepsilon_1^2 + \varepsilon_2^2})$

$\varepsilon_2 = 2nk$ $2k^2 = (-\varepsilon_1 + \sqrt{\varepsilon_1^2 + \varepsilon_2^2})$

---

* $\tilde{N}$ is sometimes written as $n(1 + iK)$.

If $\phi \to 0$ then the reflectance at normal incidence becomes

$$R = |\tilde{r}|^2 = \frac{(n-1)^2 + k^2}{(n+1)^2 + k^2} . \qquad (12)$$

In any case, the measured reflectance is

$$R = |\tilde{r}|^2 . \qquad (13)$$

The absorption coefficient μ is

$$\mu = 4\pi\, k/\lambda \qquad (14)$$

where λ is the wavelength in vacuum and $\mu dx = -dI/I$ is the fractional loss of flux in distance dx, leading to the decay of the photon flux in the material as $\exp(-\mu x)$.

One can also study the optical properties of a solid with electrons rather than photons. The probability that a fast electron loses energy E in traversing a thin film of material with dielectric function $\tilde{\varepsilon}(E)$ is proportional to[14-16]

$$\mathrm{Im}(-1/\tilde{\varepsilon}) = \varepsilon_2/(\varepsilon_1{}^2 + \varepsilon_2{}^2) \qquad (12)$$

By making suitable corrections to the measured intensity of the transmitted electron beam and by the use of a dispersion integral, it is possible to determine $\tilde{\varepsilon}(E)$. (There are additional corrections to be made for surface effects, for Čerenkov radiation, and for cases in which the incident electron is not sufficiently energetic.)

If the photon energy becomes high, larger than ~50 eV depending on the material, the above expressions simplify to

$$n = 1 - \delta \qquad (13)$$

with $k \ll 1$ and $\delta \ll 1$. Then

$$\varepsilon_1 = n^2 - k^2 \simeq 1, \qquad (14)$$

$$R = \frac{(n-1)^2 + k^2}{(n+1)^2 + k^2} \simeq \frac{\delta^2 + k^2}{4 - 2\delta} \ll 1 ,$$

$$\mathrm{Im}(-1/\tilde{\varepsilon}) \simeq \varepsilon_2 .$$

A useful optical quantity in the visible and infrared is the spectral emissivity, $e(\omega)$, the fraction of blackbody radiation with a particular polarization emitted into a differential solid angle by the sample surface[17]. For an opaque sample with a flat surface this is equal to the absorptance, $A = 1 - R$, with the foregoing expressions giving R, the reflectance. (This is Kirchhoff's law.) The spectral hemispherical emittance is the sum of the integrals of the above emittance over 2π steradians for each polarization. The total hemispherical emittance at temperature T is the integral of the latter over the blackbody spectrum, divided by the blackbody spectral integral, both at temperature T. The hemispherical spectral emittance can be put into closed form as[18]

$$\sum_{\mathrm{pol}} \frac{1}{\pi} \int_{\mathrm{hemis}} e_{\mathrm{pol}}(\omega,\alpha,\beta) \cos\alpha\, d\Omega = 4n - 4n^2 \ln\left(\frac{1 + 2n + n^2 + k^2}{n^2 + k^2} \right) \qquad (18)$$
$$+ \frac{4n(n^2 - k^2)}{k} \tan^{-1}\left(\frac{k}{n + n^2 + k^2} \right)$$
$$+ \frac{4n}{n^2 + k^2} - \frac{4n^2}{(n^2 + k^2)^2} \ln(1 + 2n + n^2 + k^2)$$
$$+ \frac{4n(n^2 - k^2)}{k(n^2 + k^2)} \tan^{-1}\left(\frac{k}{1 + n}\right) .$$

where $d\Omega = \sin\alpha d\alpha d\beta$. α and β are the polar and azimuthal angles ($\alpha = \phi$, the angle of incidence used previously, and often there is no β-dependence). [The factor of π represents $\int_{\mathrm{hemis}} 1 \cos\alpha d\Omega$, the spectral hemispherical emissivity of a blackbody of unit spectral emissivity, i.e. the normalizing factor.]

METHODS AND MEASUREMENT AND ERRORS

In general, any measured quantity can be expressed in terms of ϵ_1 and ϵ_2 or n and k, but, since both real and imaginary parts of the dielectric function appear in the expression, two measurements are needed at each frequency to obtain two equations from which $\tilde{\epsilon}$ or $\tilde{N}$ can be found. There are four general categories of measurement: (1) photometric, (2) photometric with dispersion integrals, (3) ellipsometric, and (4) electron energy loss with dispersion integrals. Space limitations preclude a detailed discussion of each, but a few general statements seem to be in order[19].

(1) Photometric[20-40]. Two quantities involving the reflected photon flux, or possibly the flux transmitted through thin films, are measured. Examples are the reflectance of p-polarized light at two angles of incidence; the angle at which the p-polarized reflectance is a minimum and the value of R_p there; and even R_p and $dR_p/d\phi$ at some ϕ. More than two measurements may be made, e.g. R_p vs. ϕ, and the data fitted to $R_p(\phi)$. Experimental errors may involve all of the following: nonlinearity of the detector, nonhomogeneity and polarization sensitivity of the detector, failure to collect all reflected flux, and the use of different surface areas if two angles of incidence are used. These measurement errors may be very difficult to estimate. If an estimate can be made, it is relatively easy to determine how the errors will propagate to produce errors in n and k. Such an error analysis can be used to select the best, or at least better, quantities to measure for a sample of assumed optical properties. In general there is not a universal best method. The sample, its properties, and the wavelength region make some methods better than others.

(2) Photometric with dispersion integrals[2,5,41-55]. Here one measures R at fixed ϕ (often near-normal incidence) and fixed polarization over as wide a frequncy range as possible. The real and imaginary parts of the reflection coefficient $\tilde{r} = re^{i\theta}$ or of

$$\ln r = \ln(re^{i\theta}) = \ln(\sqrt{R}e^{i\theta}) = \tfrac{1}{2}\ln R + i\theta \qquad (19)$$

obey a dispersion or Kramers-Kronig integral. With suitable extrapolations beyond the range of the data, one can obtain $\theta(\omega)$ from $R(\omega)$. Errors in the measured reflectance then appear in the derived dielectric function as with other methods, but there are additional errors associated with the extrapolations. In general, the extrapolation errors affect the magnitude of ϵ_1 and ϵ_2 much more than they affect the positions and shapes of spectral structures. We have found, for example, that in Mo our dielectric function results obtained using dispersion integrals and measurements of $R(\omega)$ for 0.1-30 eV agree with $\tilde{\epsilon}$ data obtained by photometric and ellipsometric methods to within 10%, while an error analysis yields an estimate of possible errors of up to 50%.

The availability of some transmission or electron energy loss data above 30 eV reduces the expected extrapolation errors, as does requiring the extrapolation to give reasonable values for the sum rule on ϵ_2 in the region of the extrapolation. A "variation" of the Kramers-Kronig method is to fit a reflectance spectrum with a series of oscillators, whose dielectric function then is represented by that of the sum of oscillators[56-57].

(3) Ellipsometric[58]. The ratio of reflected electric fields for p- and s-polarization is

$$\tilde{r}_p/\tilde{r}_s = (r_p/r_s)e^{i(\theta_p-\theta_s)} = \rho e^{i\Delta} \qquad (20)$$

The change in the state of polarization of reflected light can be measured, giving ρ and Δ, from which $\tilde{\epsilon}$ can be found. Ellipsometry has been carried out on metals since the time of Drude, but only relatively recently have data been taken at more than a few discrete wavelengths. Automatic ellipsometers now exist, often yielding $\tilde{\epsilon}$ vs. ω directly with an on-line computer. Errors in ellipsometry can be different from those in photometry. The alignment of the polarizing elements is very important and can lead to errors. Ellipsometry is rarely carried out at energies above 6 eV for lack of effective polarizing elements.

(4) Electron energy loss[14-16]. As mentioned previously, energy analysis of energetic electrons passing through thin films can give $\mathrm{Im}(-1/\tilde{\epsilon})$. This quantity is related to $\mathrm{Re}(-1/\tilde{\epsilon})$ by a dispersion integral. Thus with suitable extrapolations, and possibly with a normalization factor based on other data, $\tilde{\epsilon}$ can be obtained. In the measurement of electron energy loss spectra one must substract out not only the surface losses but also multiple losses. In fact, the response of the solid to fast electrons is governed by the longitudinal dielectric function while the response to photons is governed by the transverse function. To date, experimental differences between them are negligible for purposes of this document.

All these methods are difficult to apply to metals in the infrared because $R \to 1$ for all ϕ and $\rho \to 1$. For photometric methods one can measure the absorptance, $A = 1 - R$, in methods (2) or use large angles of incidence in methods (1). In ellipsometry one can also use large angles of incidence and multiple (m) reflections to obtain $\rho^m \exp(im\Delta)$. Finally, electron energy loss measurements usually do not have sufficient resolution to be used for metals in the infrared, i.e. $h\nu \leq 1$ eV, since the zero-loss spectrum may have a width of up to 0.5 eV.

Above ~30 eV the reflectance of all materials quickly falls to values below 0.01 except at large angles of incidence. The primary methods of

determining $\tilde{\epsilon}(\omega)$ then consist of fitting R vs. ϕ for large values of ϕ, transmission measurements which give μ, or electron energy loss measurements which then require significant corrections for multiple scattering. The latter two require the use of dispersion integrals to get real and imaginary parts of $\tilde{\epsilon}$. New types of errors arise, such as pinholes in thin-film samples, increased scattering from surface roughness as the wavelength decreases, and incompletely collimated radiation.

In all cases the most important kinds of error have not yet been mentioned. All methods make use of the Fresnel relations, derived for a flat smooth interface between two media. (This is so for the electron energy loss measurements, too, for the surface corrections rely on a description of the interface between the sample and vacuum.) Surface roughness, oxide films, and surface stresses all cause errors because the actual sample departs from the ideal strain-free material with a smooth, abrupt vacuum interface. The errors which can arise from these departures from ideality are different for each type of measurement. A rough surface, for example, will make the measured reflectance too low if any scattered radiation fails to reach the detector[59-63]. A new structure, typically a reflectance dip, may appear in the reflectance if non-radiative surface plasmons are excited at the rough surface. Ellipsometric methods are less sensitive to roughness, but only insofar as the scattered radiation is not preferentially of one polarization. A transparent oxide will lower the measured reflectance, but in the infrared such an effect is negligibly small for a metal, while submonolayer coverages of transparent oxides can be measured ellipsometrically, causing significant error if unsuspected. In the ultraviolet, oxides are strongly absorbing and cause significant errors in all types of measurement, but those sampling the bulk more than the surface, e.g. electron energy loss measurements, are less sensitive to oxides.

In order to obtain the dielectric function of a metal a strain-free, clean, flat crystalline surface is needed. In principle, the surface should be cleaned *in situ*, with cleanliness verified by Auger spectroscopy, and checked for crystallinity, and perhaps strain, by LEED or high-energy electron diffraction (RHEED). This must be done in ultra high vacuum to insure subsequent surface cleanliness. Only then should the optical properties be measured. Unfortunately, such studies have not been performed for most metals in even limited spectral ranges. Moreover, in data taken just at one or at a few fixed wavelengths on truly clean surfaces, evaluations of surface roughness have not been made. Most surface cleaning techniques e.g., Ar^+ bombardment followed by an anneal, can lead to roughened surfaces. Certainly the older techniques of cleaning by Ar^+ glow-discharge sputtering creates rough surfaces. One may have to choose between a rough, atomically clean surface and a smooth "dirty" one with a few monolayers of oxide, although in some cases a compromise may be reached. A compromise often used has been to electropolish the samples. This leaves a smooth, strain-free surface, but one with an overlayer of oxide, often containing Cl as well if perchloric acid, $H_2C\ell O_3$, is used as the electrolyte[64]. Such treatment causes little error in the infrared reflectance, but above about 6 eV the 2p electrons of oxygen absorb and cause errors. Of course the amount of error varies from sample to sample because of the oxidation processes itself; the oxidation rate also varies for different crystalline faces of a single crystal.

Thin films may be evaporated onto flat substrates, but they are inherently strained, polycrystalline samples. Strain will broaden structure in the optical spectra and the polycrystalline character may introduce special effects due to grain boundaries or voids. Annealing of the film during deposition (hot substrate) or afterward will reduce the strain but at the expense of surface roughness. Recently it was shown that many conflicting spectra obtained on thin films of Au could be reconciled by assuming different degrees of porosity in the films, up to 10% maximum. In general, such voids lower the magnitudes of ε_1 and ε_2, an effect which can be viewed in zero order as an averaging in the dielectric function of the film with that of the voids, approximated by vacuum[65]. The spectra of many films measured over the years have agreed in shape but not in magnitude. In another view of grain boundaries in films the infrared energy dependence of $\tilde{\varepsilon}(\omega)$ has been interpreted with a two-medium model in which the grain boundary material has a lower electron density and a higher electron scattering (damping) rate[66,67].

For purposes of calculating mirror or interference filter performance, it may be desirable to use data taken on films, voids and all, in order to model better the performance of samples which will, in fact, be vapor deposited films. For this purpose, the tabular data reported in this volume are less suitable than some of the data we have shown in our comparison figures since the tabular data were measured with bulk samples. Furthermore, for some of the hcp metals we present tabular data for oriented single crystals with $\vec{E} \parallel \hat{c}$ and $\vec{E} \perp \hat{c}$ to display the optical anisotropy of the material. In principle, for a polycrystalline film with randomly-oriented grains, $\tilde{\varepsilon}(\omega) = 1/3\ \tilde{\varepsilon}_{\parallel}(\omega) + 2/3\ \tilde{\varepsilon}_{\perp}(\omega)$, but in practice the film may grow preferentially with basal plane orientation along the surface ($\hat{c}$ perpendicular to the surface).

USE AND MISUSE OF THE DATA

The data presented in this document represent our assessment of the literature. Some idea of the discrepancies between the data presented and other data is also given. A glance at some of the data we do not present but list only by reference will show that there can be extremely large discrepancies, not only in the magnitudes of $\tilde{\epsilon}$ and $\tilde{\sigma}$ but even in the occurrence and non-occurrence of spectral features. We believe that the data tabulated are good to within ±10% in most cases (except near places where ϵ_1 crosses zero, for which a relative error is meaningless). The potential user should keep this 10% figure in mind for critical applications. Exceptions can be identified by examination of the figures.

The data are intended to represent the optical properties of pure, flat, strain-free, oxide-free samples. Effects of overlayers can be calculated in a straightforward manner. Departures from flatness are another matter. Slight surface roughness can be handled but in extreme cases, such as gold black or dendritic tungsten surfaces, the optical properties of the sample do not resemble those of the metal at all, purely for morphological reasons. The data could, however, be used to model such materials and cermets unless the particle size becomes too small.

We should also mention that the data are appropriate only for the normal room temperature or liquid helium temperature phase of the material. The data for fcc Ni are not at all close to those for amorphous Ni (not given), nor can the data for bcc Fe be used for the high temperature fcc phase of that metal. The effects of magnetic ordering are less extreme, but are sometimes important. For example, the data for Cr taken at 4.2 K show a small peak near 0.1 eV which is a result of the antiferromagnetic ordering. As the temperature increases, this peak weakens and broadens and is very difficult to see at room temperature, even though Cr is still antiferromagnetic.

The functions $\tilde{\epsilon}$ and $\tilde{\sigma}$ can be calculated theoretically. As presented here they are local functions, i.e. the material is presumed to have no special effects due to the surface, and the anomalous skin effect has been ignored in obtaining $\tilde{\epsilon}$ from the measured data. This latter effect[2,5] can be significant for single crystals at and below room temperature in the near, and especially the far, infrared. The data can be applied without correction to evaporated films, whose mean free path is usually short. To deal properly with single crystals in the infrared, whenever interband absorption does not dominate, one should abandon the $\tilde{\epsilon}$ concept and work with the reflectance itself or the surface impedance[2], $\tilde{Z} = (4\pi/c)\tilde{E}/\tilde{H}$, where the fields are the tangential components evaluated at the surface. Then $\tilde{r} = (4\pi/c-\tilde{Z})/(4\pi/c+\tilde{Z})$ at normal incidence.

Finally, we have presented room temperature or liquid helium temperature data only. Many applications require data at high temperature, e.g., optical pyrometry and solar-thermal energy applications. Provided oxides or surface roughness do not increase at the higher temperatures, one can use the room temperature data for many applications. There are two ways to obtain the temperature dependence. One can make measurements, e.g. of the reflectance at all temperatures of interest, but in addition to the problems of enhanced oxidation and possible surface roughening at high temperature, problems with sample evaporation and the blackbody radiation of the sample itself arise. At temperatures above ~1000 K the emissivity is usually what is measured, by comparing the radiation from the sample with that from a cavity, often in the sample itself. The other method measures directly the temperature derivative of the reflectance or absorptance of the sample, by modulation spectroscopic techniques with a calibration determined by a steady-state calorimetric method.

REFERENCES

1. M. Born and E. Wolf, "Principles of Optics". (Pergamon Press, London, 1959).
2. F. Stern, Solid State Physics 15, 299 (1963).
3. L.D. Landau and E.M. Lifshitz, "Electrodynamics of Continuous Media", (Addison-Wesley, Reading, Mass., 1965).
4. A.V. Sokolov, "Optical Properties of Metals", (Blackie, London, 1967).
5. F. Wooten, "Optical Properties of Solids", (Academic, New York, 1972).
6. H. Wolter, Handbuch der Physik 24, 461 (1956).
7. J.F. Nye, "Physical Properties of Crystals", (Oxford University Press, London, 1957).
8. C.S. Smith, Solid State Physics 6, 175 (1958).
9. M. Altarelli, D.L. Dexter, H.M. Nussenzveig, and D.Y. Smith, Phys. Rev. B 6, 175 (1958).
10. A. Villani and A.H. Zimmerman, Phys. Rev. B 8, 3914 (1973).
11. M. Altarelli and D.Y. Smith, Phys. Rev. B 9, 1290 (1974); B 12, 3511 (1975).
12. D.Y. Smith, Phys. Rev. B 12, 5303 (1976).
13. E. Shiles, T. Sasaki, M. Inokuti, and D.Y. Smith, Phys. Rev. B 22, (1980) (in press).
14. H. Raether, "Springer Tracts in Modern Physics", Vol. 38 (Springer-Verlag, Berlin, 1965).
15. J. Daniels, C.v. Festenberg, H. Raether, and K. Zeppenfield, "Springer Tracts in Modern Physics", Vol. 54 (Springer-Verlag, Berlin, 1970).
16. H. Raether, "Springer Tracts in Modern Physics", Vol. 88 (Springer-Verlag, Berlin, 1980).
17. H.P. Baltes, "Progress in Optics", XIII, 1 (1976) ed. E. Wolf.
18. R. Siegel and J.R. Howell, "Thermal Radiation Heat Transfer", (McGraw-Hill, New York 1972) p. 109.
19. D.W. Lynch, J. de Physique Suppl. 77, 15-21 (1977).
20. I. Simon, J. Opt. Soc. Am. 41, 334 (1951).

REFERENCES (cont'd)

21. W.R. Hunter, J. Opt. Soc. Am. 55, 1197 (1965).

22. W.R. Hunter, Appl. Opt. 6, 2140 (1967).

23. D.G. Avery, Proc. Phys. Soc. (London) B65, 425 (1952).

24. R.E. Lindquist and A.W. Ewald, J. Opt. Soc. Am. 53, 247 (1963).

25. B.F. Armally et al., Appl. Opt. 11, 2907 (1972).

26. S.P.F. Humphreys-Owen, Proc. Phys. Soc. (London) 77, 949 (1961).

27. R.F. Potter, J. Opt. Soc. Am. 54, 904 (1964).

28. R.F. Potter, Appl. Opt. 4, 53 (1965).

29. O. Hunderi, Appl. Opt. 11 1572 (1972).

30. A. Balzarotti, P. Picozzi, and S. Santucci, Surf. Sci. 37, 994 (1973).

31. W.R. Hunter, J. Opt. Soc. Am. 54, 15 (1964); 55, 1197 (1965).

32. U.S. Whang, E.T. Arakawa, and T.A. Callcott, J. Opt. Soc. Am. 61, 740 (1971).

33. U.S. Whang, E.T. Arakawa, and T.A. Callcott, Phys. Rev. B 5, 2118 (1972); B 6, 2409 (1972).

34. P.O. Nilsson, Appl. Opt. 7, 435 (1968).

35. F. Abeles and M.L. Theye, Surf. Sci. 5, 325 (1966).

36. G. Baldini and L. Rigaldi, J. Opt. Soc. Am. 60, 495 (1970).

37. L. Ward and A. Nag, Brit. J. Appl. Phys. 18, 277 (1967).

38. L. Ward and A. Nag. J. Phys. D 3, 462 (1970).

39. R.F. Miller, A.J. Taylor, and L.S. Julien, J. Phys. D 3, 1957 (1970).

40. J.E. Nestell and R.W. Christy, Appl. Opt. 11, 643 (1972).

41. R.A. MacRae, E.T. Arakawa, and M.W. Williams, Phys. Rev. 162, 615 (1967).

42. B.W. Veal and A.P. Paulikas, Phys. Rev. B 10, 1280 (1974).

43. D.E. Thomas, Bell Syst. Tech. 26, 870 (1947).

44. E.L. Krieger, D.J. Olechna, and D.S. Story, General Electric Corp. Report No. 63-RL-3458G, September 1963.

REFERENCES (cont'd)

45. P.O. Nilsson and L. Munkby, Phys. Kond. Mat. 10 290 (1969).

46. B. Velicky, Czech. J. Phys. B 11, 787 (1961).

47. V.K. Miloslavskii, Opt. Spectroscop. 21, 193 (1961).

48. D.M. Roessler, Brit. J. Appl. Phys. 16, 1359 (1965).

49. G. Leveque, J. Phys. C 10, 4877 (1977).

50. D.W. Berreman, Appl. Opt. 6, 1519 (1967).

51. G.M. Hale, W.E. Holland, and M.R. Querry, Appl. Opt. 12, 48 (1973).

52. C.W. Peterson and B.W. Knight, J. Opt. Soc. Am. 63, 1238 (1973).

53. D.M. Roessler, Brit. J. Appl. Phys. 17, 1313 (1966).

54. R. Klucker and U. Nielsen, Computer Phys. Comm. 6, 187 (1973).

55. D.Y. Smith, J. Opt. Soc. Am. 67, 570 (1977).

56. H.W. Verleur, J. Opt. Soc. Am. 58, 1356 (1968).

57. J. Rivory, Optics Commun. 1, 334 (1970).

58. D.E. Aspnes, "Optical Properties of Solids, New Developments", (North Holland, Amsterdam, 1976) ed. B.O. Seraphin, p. 799.

59. H.E. Bennett and J.M. Bennett, "Physics of Thin Films", Vol. 4 (Academic Press, New York, 1967) ed. G. Hass and R.E. Thun, p. 1.

60. H.E. Bennett and J.O. Porteus, J. Opt. Soc. Am. 51, 123 (1961).

61. H.E. Bennett, J. Opt. Soc. Am. 53, 1389 (1963).

62. J.O. Porteus, J. Opt. Soc. Am. 53, 1294 (1963).

63. D.W. Berreman, Phys. Rev. 163, 855 (1967); B 2, 381 (1970).

64. A.J. Bevolo, B.J. Beaudry, and K.A. Gschneidner, Jr., J. Electrochem. Soc. (1980).

65. D.E. Aspnes, Phys. Rev. B 21, 3290 (1980).

66. O. Hunderi, Phys. Rev. B 15, 3419 (1973).

67. S.R. Nagel and S.E. Schnatterly, Phys. Rev. B 9, 1299 (1974).

Table I. List of abbreviations used in the figures and tables.

$\varepsilon_1, \varepsilon_2$	real and imaginary parts of the complex dielectric function, $\tilde{\varepsilon}(\omega) = \varepsilon_1 + i\varepsilon_2$
$-\mathrm{Im}(\tilde{\varepsilon}^{-1}), -\mathrm{Im}(\tilde{\varepsilon}+1)^{-1}$	volume and surface loss functions
KK	Kramers-Kronig analysis
μ	absorption coefficient
RT	room temperature, ~300 K
n,k	index of refraction and extinction coefficient, $\tilde{N}(\omega) = n + ik$
σ	optical conductivity, $\sigma = \varepsilon_2\omega/4\pi$
T	temperature; transmission (if it appears in data presentation column)
A	absorptivity, A = 1 - R
R	reflectivity or reflectance
$\vec{E} \parallel \hat{c}$, $\vec{E} \perp \hat{c}$	$\vec{E}$ = electric field vector; $\hat{c}$ = crystallographic c-axis for hcp metals where c is orthogonal to the basal plane
$\varepsilon, \varepsilon_H, \varepsilon_N$	emissivity, hemispherical emissivity, normal emissivity
MP	mechanical polishing
Ex, In	ex situ, in situ
uhv	ultra high vacuum (generally ~10^{-9} Torr or better)
TEM	transmission electron microscopy
LEED	low energy electron diffraction
AES	Auger electron spectroscopy
Trans	transmission
Refl	reflection
m-θ	multi-angle
Ellips	ellipsometry
Sput	Argon-sputtering, generally implies post-sputtering annealing
EP	electropolish
CP	chemically polished

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Tl
				Film	X-tal	Bulk	Prep		
Sa39	2.6-27.6	Refl		x			Ex	R	
HB57	0.12-12.4	Ellips		x			Ex	R,n,k	
BVK62	0.12-0.62	Ellips				x	MP	$n,k,\varepsilon_1,\varepsilon_2,R$	
KC63	0.06-0.5	Ellips				x	MP	n,k	
KCh63	0.31-2.61	Ellips				x	MP	n,k,σ	
LSE64	109-539	Trans		x			Ex	μ	
KC65	0.05-5	Ellips				x	MP	$n,k,\sigma,R,\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda, -\varepsilon_1$	
VAK67	3-14.4					x	MP	R	technique: polarimetry for $3 < h\nu < 5$ eV reflectance for $4 < h\nu < 7$ eV photoyield for $7.5 < h\nu < 14.4$ eV
KNB68	5-12	Ellips				x	MP	R; KK: $\sigma, \mathrm{Im}(\varepsilon^{-1}), \mathrm{Im}(\varepsilon+1)^{-1}, \varepsilon_1$	data taken from VAK67, then KK analyzed
SHK69	40-300	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
AB71			1000-1700			x		ε at λ = 6500 Å	emissivity
PD71			1200-2200			x		ε_H	emissivity
MM72	0.12-3.1	Trans, Ellips				x	EP	n,k,σ	
Sm72	1.96, 2.27	Ellips	~280-2100		x		In	n,k	sputtered, annealed, AES

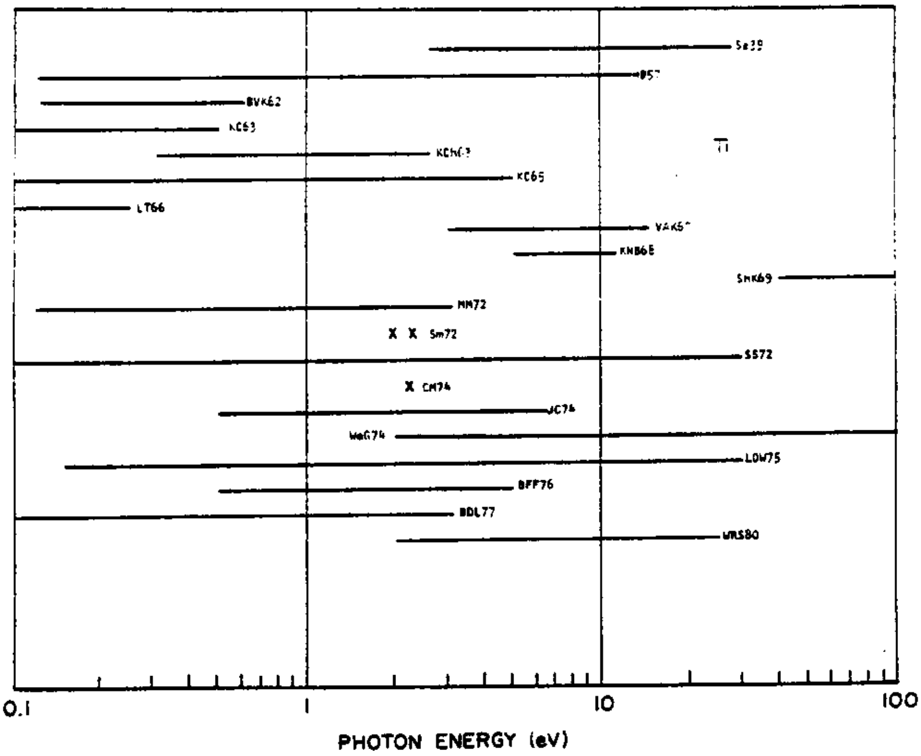

Fig. 2 Survey of available data for Ti

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Ti
				Film	X-tal	Bulk	Prep		
SS72	~0-30			x				$\mathrm{Im}(\varepsilon^{-1})$	technique: energy loss spectroscopy, AES
BaB74			1100-1800			x		ε_N at $\lambda = 6450$ Å	emissivity
CM74	2.27	Ellips		x	x		uhv	R,n,k	ultra high vacuum, LEED, single crystal
JC74	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	
WeG74	2-130	Trans		x			Ex	KK: μ	technique: energy loss spectroscopy
WGa74	2-120	Trans		x			Ex	$\mu, \mathrm{Im}(\varepsilon^{-1})$; KK: $\varepsilon_1, \varepsilon_2$	technique: energy loss spectroscopy
LOW75	0.15-30	Refl	4.2 K for hν < 4.4 eV RT for hν > 4.4 eV			x	EP	A,R; KK: $\varepsilon_1, \varepsilon_2, \sigma$, $\mathrm{Im}(\varepsilon^{-1}), \mathrm{Im}(\varepsilon+1)^{-1}$	technique: absorption measured by calorimetry for hν < 4.4 eV, reflectivity measured for hν > 4.4 eV with synchrotron radiation
BFF76	0.5-5	Refl		x				R,n,k	
BDL77	0.03-3.1	Refl				x		R	also emittance 400 ≤ T ≤ 850 K
CM77			1945			x		ε_N at $\lambda = 6530$ Å	emissivity
WRS80	2-25	Refl				x	Sput	R; KK: $\varepsilon_1, \varepsilon_2$	AES used to characterize Ti and TiO_x

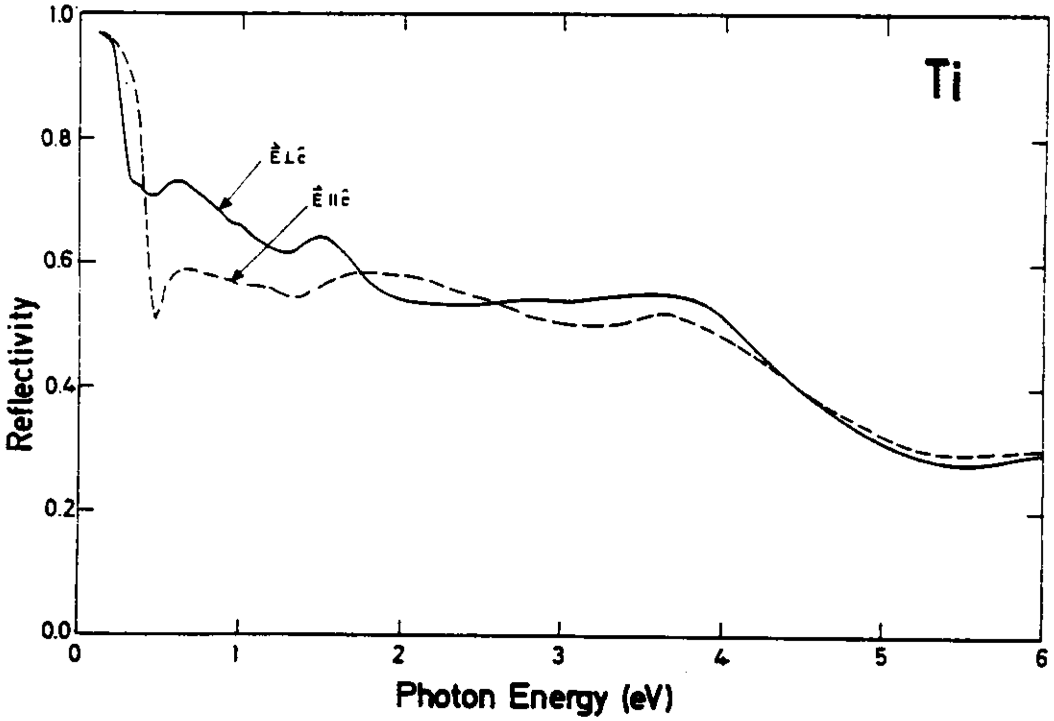

Fig. 3b Reflectivity of single crystal Ti for $\vec{E}\parallel\hat{c}$ (dashed line) and $\vec{E}\perp\hat{c}$ (solid line) by LOW (unpub).

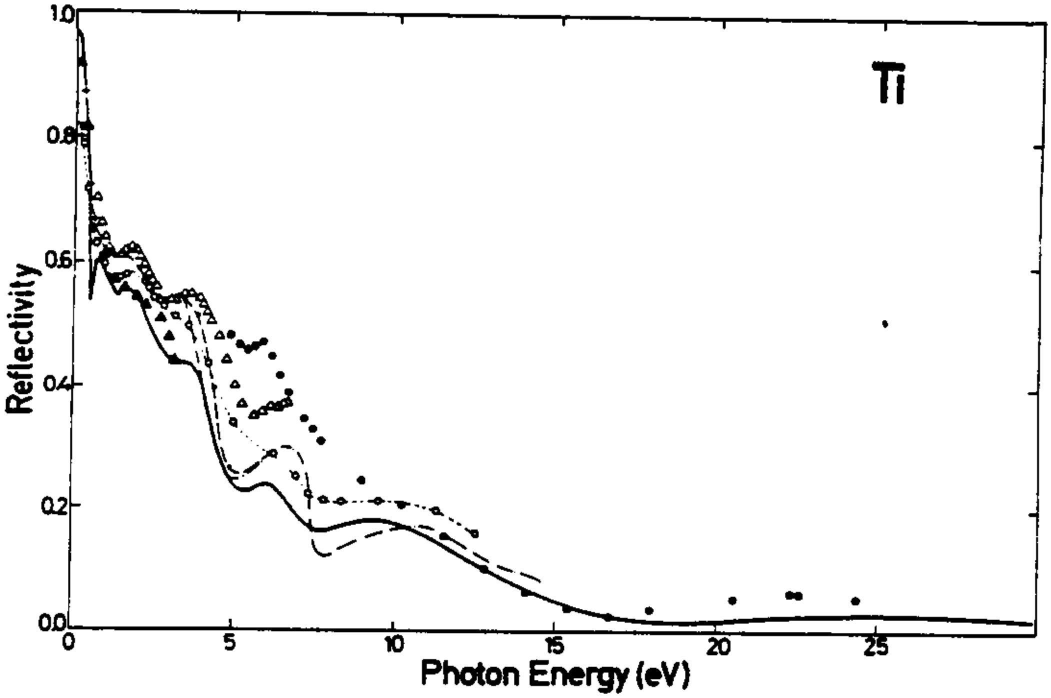

Fig. 3a Reflectivity of Ti. All spectra are for polycrystalline samples. ——— LOW75; ---- KC65; -o-o- HB57; ----- VAK67; ···· WRS80; ▲▲▲ MM72; ΔΔΔ JC74.

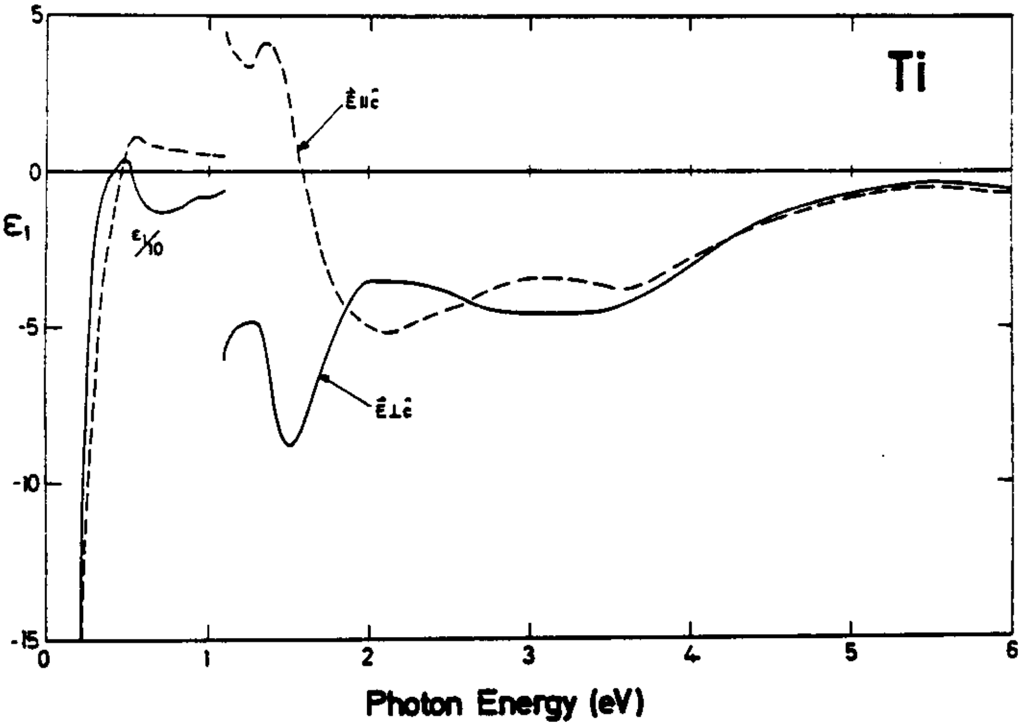

Fig. 4b ϵ_1 for single crystal Ti for $\vec{E}\parallel\hat{c}$ (dashed line) and $\vec{E}\perp\hat{c}$ (solid line) by LOW (unpub).

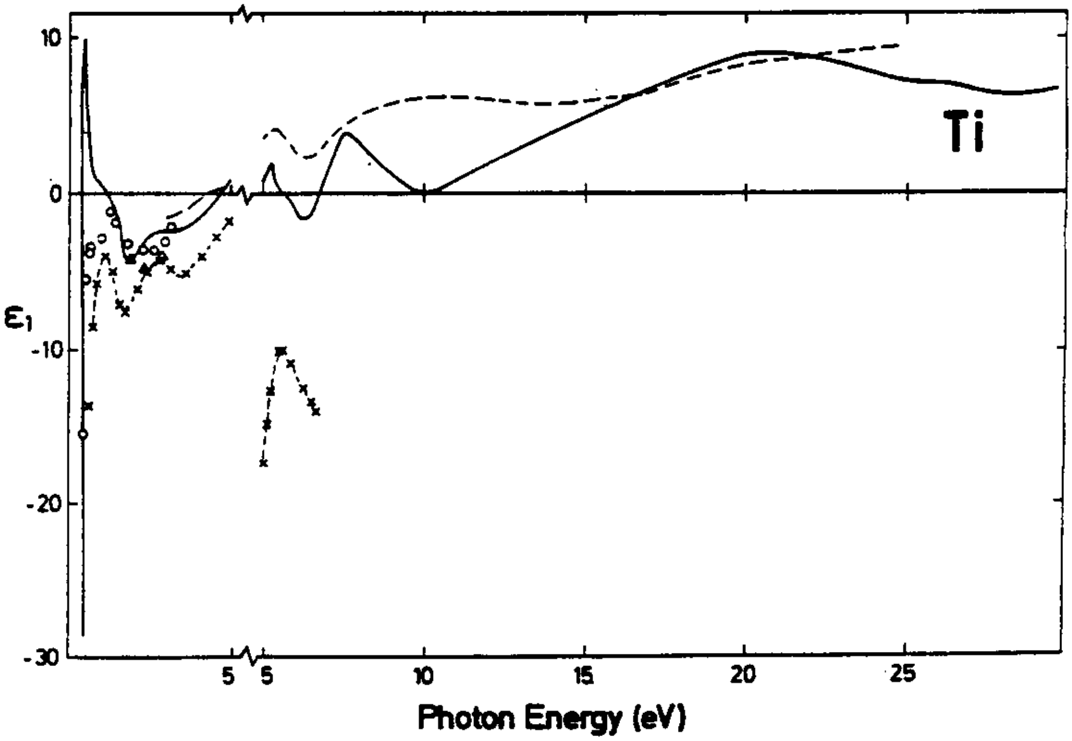

Fig. 4a ϵ_1 for polycrystalline Ti. —— LOW75; xxx JC74; ---WRS80; ooo MM72; ΔΔΔ HB57.

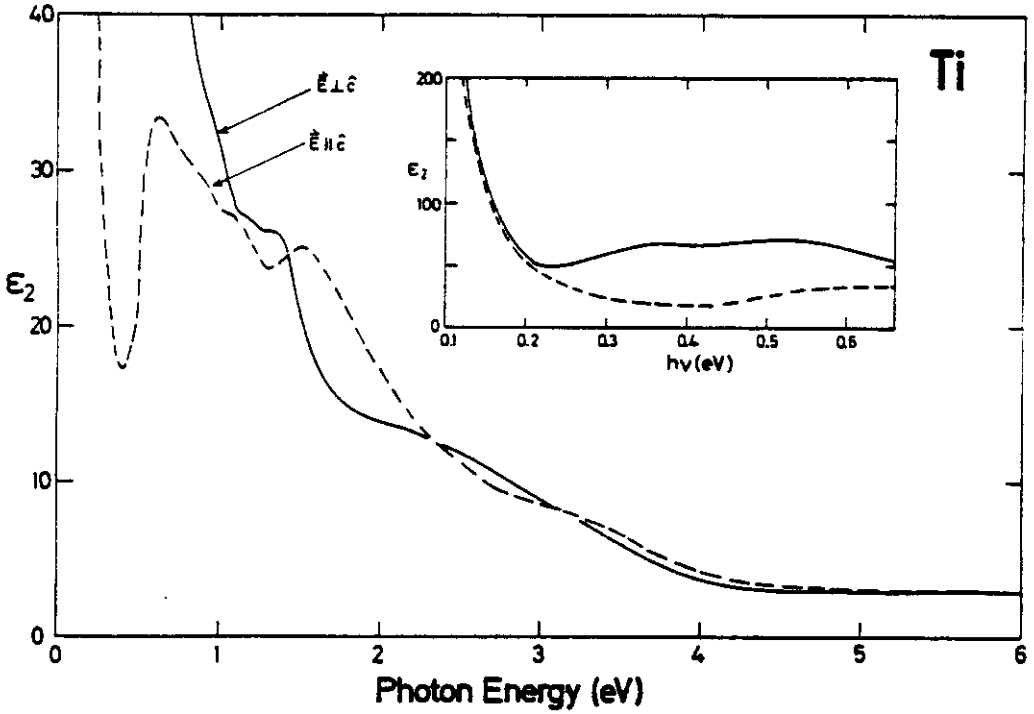

Fig. 5b ε_2 for single crystal Ti for $\vec{E}\parallel\hat{c}$ (dashed line) and $\vec{E}\perp\hat{c}$ (solid line) by LOW (unpub).

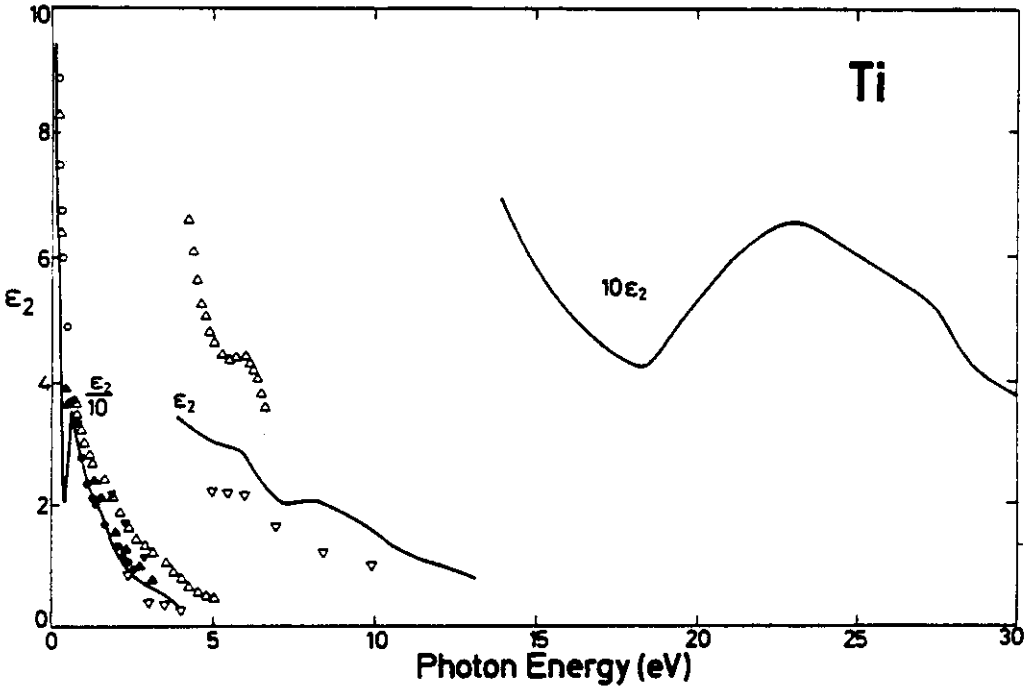

Fig. 5a ε_2 for polycrystalline Ti. —— LOW75; ▼▼▼ HB57; ▽▽▽ WRS80; ▲▲▲ MM72; ooo KC65; ●●● KC63; ΔΔΔ JC74.

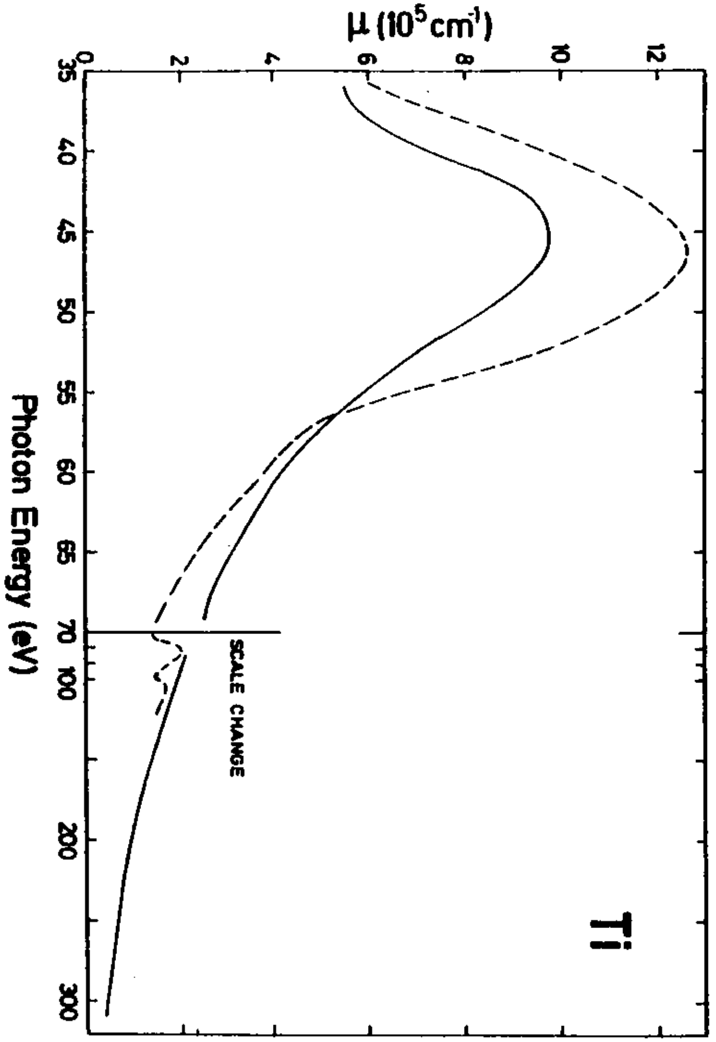

Fig. 6 Absorption coefficient for Ti. —— SHK69; --- WeG74.

Polycrystalline Titanium

publication by D.W. Lynch, C.G. Olson, and J.H. Weaver in Phys. Rev. B 11, 3617 (1975) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-1825.31	1181.84	13.21	44.72	0.00	.976
0.13	-1250.94	728.16	9.91	36.73	0.00	.973
0.10	-521.17	235.09	5.03	23.38	0.00	.965
0.11	-440.25	192.20	4.48	21.45	0.00	.963
0.12	-376.24	154.38	3.90	19.79	0.00	.962
0.13	-320.15	127.16	3.49	18.23	0.00	.960
0.14	-274.29	108.76	3.22	16.87	0.00	.957
0.15	-237.95	94.37	3.00	15.72	0.00	.954
0.16	-209.28	82.60	2.81	14.70	0.00	.951
0.17	-183.45	71.65	2.60	13.79	0.00	.949
0.18	-161.49	62.34	2.41	12.94	0.00	.946
0.19	-141.90	54.18	2.23	12.12	0.00	.943
0.20	-124.05	48.02	2.12	11.34	0.00	.938
0.21	-108.32	43.28	2.04	10.61	0.00	.933
0.22	-94.41	39.66	2.00	9.92	0.00	.926
0.23	-82.05	36.75	1.98	9.27	0.00	.916
0.24	-70.97	34.65	2.01	8.66	0.01	.904
0.25	-61.37	33.23	2.05	8.10	0.01	.890
0.26	-52.80	31.51	2.08	7.56	0.01	.875
0.27	-44.65	27.94	2.00	6.98	0.01	.861
0.28	-29.92	16.14	1.43	5.65	0.01	.849
0.29	7.91	25.37	4.15	3.06	0.04	.537
0.30	-57.91	127.04	6.39	9.94	0.01	.843
0.31	-48.99	56.67	3.60	7.87	0.01	.827
0.32	-43.10	46.19	3.17	7.29	0.01	.820
0.33	-38.61	40.54	2.95	6.88	0.01	.813
0.34	-33.56	36.81	2.82	6.52	0.01	.802
0.35	-31.10	33.99	2.74	6.21	0.02	.792
0.36	-28.00	31.62	2.67	5.93	0.02	.780
0.37	-25.26	29.25	2.59	5.65	0.02	.769
0.38	-22.28	26.92	2.52	5.35	0.02	.754
0.39	-19.02	24.92	2.48	5.02	0.03	.733
0.40	-15.69	23.26	2.49	4.68	0.03	.706
0.41	-12.12	22.09	2.56	4.32	0.03	.675
0.42	-8.64	21.43	2.69	3.98	0.04	.635
0.43	-5.30	21.19	2.88	3.68	0.04	.598
0.44	-2.23	21.32	3.10	3.44	0.05	.567
0.45	0.67	21.75	3.35	3.25	0.05	.545
0.46	3.37	22.59	3.62	3.12	0.04	.534
0.47	5.62	23.94	3.89	3.08	0.04	.533
0.48	7.31	25.53	4.11	3.10	0.04	.540
0.49	8.49	27.08	4.29	3.15	0.03	.548
0.50	9.27	28.50	4.43	3.22	0.03	.555
0.52	10.16	30.95	4.62	3.35	0.03	.564
0.54	10.09	33.09	4.73	3.50	0.03	.580
0.56	9.47	34.37	4.75	3.62	0.03	.589
0.58	8.67	35.13	4.74	3.71	0.03	.594
0.60	7.94	35.47	4.71	3.77	0.03	.597
0.62	7.07	35.74	4.66	3.83	0.03	.601

Ti

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
0.64	6.09	35.65	4.60	3.88	0.03	.603
0.66	5.21	35.23	4.52	3.90	0.03	.604
0.68	4.57	34.64	4.44	3.90	0.03	.603
0.70	4.06	34.09	4.38	3.89	0.03	.603
0.72	3.53	33.60	4.32	3.89	0.03	.602
0.74	2.97	33.01	4.25	3.88	0.03	.601
0.76	2.46	32.33	4.18	3.87	0.03	.600
0.78	2.07	31.59	4.11	3.85	0.03	.598
0.80	1.70	30.87	4.04	3.82	0.03	.596
0.82	1.13	29.96	3.94	3.80	0.03	.594
0.84	2.19	28.72	3.94	3.75	0.03	.592
0.86	1.52	28.59	3.93	3.73	0.03	.589
0.88	1.20	28.44	3.85	3.69	0.04	.586
0.90	1.11	27.80	3.80	3.65	0.04	.582
0.92	1.08	27.27	3.77	3.62	0.04	.579
0.94	0.99	26.83	3.73	3.60	0.04	.577
0.96	0.88	26.38	3.69	3.57	0.04	.575
0.98	0.78	25.91	3.65	3.55	0.04	.573
1.00	0.74	25.46	3.62	3.52	0.04	.570
1.05	0.57	24.50	3.54	3.46	0.04	.565
1.10	0.44	23.61	3.47	3.40	0.04	.560
1.15	0.34	22.78	3.40	3.35	0.04	.555
1.20	0.33	22.08	3.35	3.30	0.05	.550
1.25	0.31	21.60	3.31	3.26	0.05	.547
1.30	0.10	21.31	3.28	3.26	0.05	.546
1.35	-0.23	21.07	3.23	3.26	0.05	.547
1.40	-0.73	20.76	3.17	3.28	0.05	.549
1.45	-1.34	20.41	3.08	3.31	0.05	.553
1.50	-2.15	19.81	2.96	3.32	0.05	.557
1.55	-2.85	19.05	2.87	3.33	0.05	.559
1.60	-3.36	18.09	2.74	3.30	0.05	.559
1.65	-3.52	17.19	2.65	3.24	0.06	.556
1.70	-3.95	16.43	2.54	3.23	0.06	.557
1.75	-4.08	15.48	2.44	3.17	0.06	.554
1.80	-4.11	14.68	2.36	3.11	0.06	.550
1.85	-4.07	13.94	2.29	3.05	0.07	.545
1.90	-4.00	13.27	2.22	2.99	0.07	.540
1.95	-3.92	12.68	2.16	2.93	0.07	.535
2.00	-3.86	12.13	2.11	2.88	0.07	.530
2.10	-3.65	11.13	2.01	2.77	0.08	.520
2.20	-3.41	10.26	1.92	2.67	0.09	.509
2.30	-3.09	9.54	1.86	2.56	0.09	.495
2.40	-2.83	8.97	1.81	2.47	0.10	.483
2.50	-2.57	8.51	1.78	2.39	0.11	.471
2.60	-2.39	8.16	1.75	2.34	0.11	.462
2.70	-2.30	7.84	1.71	2.29	0.12	.456
2.80	-2.24	7.53	1.68	2.25	0.12	.451
2.90	-2.21	7.23	1.63	2.21	0.13	.447
3.00	-2.19	6.93	1.59	2.17	0.13	.444
3.10	-2.21	6.65	1.55	2.15	0.14	.442
3.20	-2.25	6.34	1.50	2.12	0.14	.442
3.30	-2.29	6.02	1.44	2.09	0.15	.442
3.40	-2.35	5.66	1.37	2.06	0.15	.443
3.50	-2.35	5.26	1.30	2.01	0.16	.443
3.60	-2.31	4.85	1.24	1.96	0.17	.441
3.70	-2.22	4.45	1.17	1.90	0.18	.436
3.80	-2.11	4.04	1.11	1.83	0.19	.433

Ti

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
3.85	-1.99	3.83	1.08	1.78	0.21	.424
3.87	-1.93	3.73	1.07	1.75	0.21	.417
3.90	-1.86	3.65	1.06	1.73	0.22	.413
3.92	-1.81	3.57	1.05	1.71	0.22	.410
3.95	-1.72	3.47	1.04	1.67	0.23	.403
3.97	-1.63	3.41	1.04	1.64	0.24	.395
3.99	-1.56	3.37	1.04	1.62	0.24	.389
4.03	-1.47	3.30	1.03	1.59	0.25	.380
4.05	-1.39	3.23	1.03	1.57	0.26	.373
4.08	-1.29	3.19	1.04	1.54	0.27	.363
4.11	-1.23	3.15	1.04	1.52	0.28	.357
4.13	-1.13	3.11	1.04	1.49	0.28	.347
4.16	-1.06	3.09	1.05	1.47	0.29	.340
4.19	-0.99	3.05	1.05	1.45	0.30	.333
4.22	-0.90	3.02	1.06	1.42	0.30	.323
4.25	-0.81	3.01	1.07	1.40	0.31	.314
4.28	-0.73	3.00	1.09	1.38	0.31	.306
4.30	-0.66	3.01	1.10	1.37	0.32	.299
4.34	-0.61	3.01	1.11	1.36	0.32	.294
4.36	-0.54	3.01	1.12	1.34	0.32	.288
4.40	-0.50	3.02	1.13	1.33	0.32	.284
4.43	-0.45	3.02	1.14	1.33	0.32	.280
4.45	-0.43	3.02	1.14	1.32	0.32	.278
4.49	-0.38	3.01	1.15	1.31	0.33	.273
4.53	-0.34	3.01	1.16	1.30	0.33	.269
4.56	-0.30	3.01	1.17	1.29	0.33	.266
4.59	-0.28	3.02	1.17	1.29	0.33	.265
4.63	-0.26	2.96	1.16	1.27	0.34	.260
4.68	-0.22	2.94	1.17	1.26	0.34	.257
4.73	-0.12	2.96	1.19	1.24	0.34	.249
4.77	-0.08	2.97	1.20	1.23	0.34	.245
4.80	-0.05	2.98	1.21	1.23	0.34	.244
4.84	-0.03	2.99	1.22	1.23	0.33	.243
4.88	-0.01	2.99	1.22	1.22	0.33	.241
4.92	0.00	2.99	1.22	1.22	0.33	.240
4.96	0.05	2.98	1.23	1.21	0.33	.236
5.00	0.05	3.00	1.24	1.21	0.33	.235
5.08	0.09	3.00	1.24	1.21	0.33	.233
5.12	0.11	3.01	1.25	1.20	0.33	.232
5.17	0.14	3.01	1.25	1.20	0.33	.230
5.21	0.17	3.03	1.27	1.20	0.33	.226
5.25	0.21	3.07	1.28	1.20	0.32	.228
5.30	0.35	3.25	1.35	1.21	0.30	.227
5.34	-0.59	3.31	1.18	1.41	0.29	.244
5.39	0.02	2.73	1.17	1.16	0.37	.229
5.44	0.08	2.92	1.23	1.19	0.34	.231
5.49	0.10	2.95	1.24	1.19	0.34	.230
5.53	0.09	2.97	1.24	1.20	0.34	.233
5.59	0.06	2.98	1.24	1.21	0.34	.234
5.64	0.06	2.96	1.23	1.21	0.34	.235
5.69	0.04	2.98	1.23	1.21	0.34	.237
5.74	0.01	2.97	1.22	1.22	0.34	.239
5.79	-0.03	2.95	1.21	1.22	0.34	.241
5.85	-0.07	2.92	1.19	1.22	0.34	.243
5.90	-0.09	2.87	1.18	1.22	0.35	.243
6.02	-0.15	2.78	1.15	1.21	0.36	.244
6.08	-0.15	2.71	1.13	1.20	0.37	.242

Ti

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
6.14	-0.16	2.66	1.12	1.19	0.37	.241
6.20	-0.16	2.60	1.11	1.18	0.38	.240
6.26	-0.16	2.54	1.09	1.16	0.39	.237
6.36	-0.14	2.44	1.08	1.14	0.41	.232
6.46	-0.09	2.37	1.07	1.11	0.42	.224
6.51	-0.12	2.32	1.05	1.10	0.43	.225
6.55	-0.07	2.28	1.05	1.08	0.44	.219
6.57	-0.03	2.21	1.04	1.06	0.45	.212
6.74	0.02	2.16	1.04	1.03	0.46	.203
6.81	0.06	2.13	1.05	1.02	0.47	.198
6.85	0.09	2.10	1.05	1.00	0.47	.194
6.93	0.12	2.08	1.05	0.99	0.48	.189
6.97	0.15	2.07	1.05	0.98	0.48	.186
7.01	0.19	2.06	1.06	0.97	0.48	.182
7.04	0.19	2.07	1.07	0.97	0.48	.182
7.09	0.19	2.06	1.07	0.97	0.48	.181
7.13	0.22	2.05	1.07	0.96	0.48	.178
7.17	0.24	2.04	1.07	0.95	0.48	.175
7.21	0.26	2.04	1.08	0.95	0.48	.174
7.25	0.29	2.04	1.08	0.94	0.48	.172
7.29	0.30	2.04	1.09	0.94	0.48	.170
7.34	0.31	2.05	1.09	0.94	0.48	.169
7.42	0.33	2.06	1.10	0.94	0.47	.168
7.47	0.35	2.07	1.11	0.94	0.47	.167
7.51	0.41	2.12	1.13	0.94	0.45	.165
7.56	0.13	2.17	1.08	1.01	0.46	.193
7.61	0.32	1.95	1.07	0.91	0.50	.163
7.65	0.34	2.02	1.09	0.92	0.48	.165
7.70	0.35	2.03	1.10	0.93	0.48	.165
7.75	0.36	2.03	1.10	0.92	0.48	.163
7.80	0.37	2.05	1.11	0.93	0.47	.164
7.85	0.37	2.06	1.11	0.93	0.47	.165
7.90	0.35	2.07	1.11	0.93	0.47	.167
7.95	0.36	2.07	1.11	0.93	0.47	.165
7.99	0.35	2.08	1.11	0.94	0.47	.164
8.05	0.33	2.08	1.10	0.94	0.47	.169
8.10	0.32	2.08	1.10	0.94	0.47	.170
8.16	0.31	2.08	1.10	0.95	0.47	.171
8.21	0.30	2.07	1.09	0.95	0.47	.172
8.27	0.29	2.07	1.09	0.95	0.47	.173
8.32	0.27	2.06	1.09	0.95	0.48	.174
8.38	0.25	2.06	1.08	0.95	0.48	.175
8.49	0.23	2.04	1.07	0.95	0.48	.177
8.55	0.21	2.03	1.06	0.96	0.49	.178
8.61	0.20	2.01	1.05	0.95	0.49	.178
8.67	0.17	2.00	1.04	0.96	0.50	.181
8.73	0.16	1.97	1.03	0.95	0.50	.181
8.79	0.15	1.95	1.02	0.95	0.51	.181
8.86	0.15	1.93	1.02	0.94	0.52	.180
8.98	0.11	1.90	1.00	0.94	0.53	.182
9.05	0.10	1.87	0.99	0.94	0.53	.182
9.11	0.11	1.84	0.99	0.94	0.54	.180
9.18	0.09	1.83	0.98	0.93	0.54	.181
9.25	0.08	1.81	0.97	0.93	0.55	.182
9.32	0.06	1.77	0.96	0.94	0.56	.183
9.39	0.07	1.74	0.95	0.91	0.57	.181
9.46	0.07	1.72	0.95	0.91	0.58	.180

Ti

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
9.54	0.06	1.70	0.94	0.90	0.59	.179
9.61	0.06	1.68	0.93	0.90	0.59	.180
9.69	0.05	1.65	0.92	0.90	0.60	.180
9.76	0.04	1.63	0.91	0.89	0.61	.180
9.84	0.04	1.60	0.91	0.88	0.62	.179
9.92	0.03	1.58	0.90	0.88	0.64	.180
9.99	0.02	1.55	0.89	0.88	0.65	.180
10.08	0.02	1.51	0.87	0.86	0.66	.179
10.16	0.02	1.48	0.86	0.85	0.68	.178
10.25	0.02	1.44	0.86	0.84	0.69	.176
10.33	0.02	1.42	0.85	0.83	0.71	.175
10.42	0.02	1.38	0.84	0.82	0.72	.174
10.50	0.03	1.35	0.83	0.81	0.74	.172
10.59	0.03	1.32	0.82	0.80	0.76	.170
10.68	0.05	1.28	0.81	0.79	0.78	.167
10.78	0.05	1.25	0.81	0.78	0.80	.166
10.87	0.06	1.21	0.80	0.76	0.82	.162
10.97	0.08	1.18	0.79	0.74	0.85	.158
11.07	0.10	1.14	0.79	0.72	0.87	.152
11.17	0.14	1.12	0.80	0.70	0.88	.145
11.27	0.17	1.12	0.81	0.69	0.88	.139
11.37	0.18	1.12	0.81	0.69	0.87	.137
11.48	0.17	1.12	0.81	0.69	0.87	.139
11.58	0.16	1.10	0.80	0.69	0.89	.140
11.69	0.16	1.07	0.79	0.68	0.92	.139
11.80	0.16	1.04	0.78	0.67	0.94	.137
11.92	0.18	1.01	0.77	0.65	0.96	.132
12.03	0.19	0.99	0.77	0.64	0.98	.130
12.09	0.20	0.97	0.77	0.63	0.99	.127
12.15	0.20	0.96	0.77	0.63	0.99	.127
12.21	0.20	0.95	0.77	0.62	1.01	.125
12.27	0.21	0.94	0.76	0.61	1.02	.124
12.33	0.22	0.93	0.76	0.61	1.03	.122
12.39	0.22	0.92	0.76	0.60	1.03	.120
12.45	0.23	0.90	0.76	0.59	1.04	.119
12.50	0.23	0.89	0.76	0.59	1.05	.117
12.58	0.24	0.88	0.76	0.58	1.06	.115
12.65	0.25	0.87	0.76	0.57	1.07	.113
12.71	0.26	0.85	0.76	0.56	1.07	.110
12.78	0.26	0.84	0.76	0.56	1.08	.109
12.84	0.27	0.83	0.76	0.55	1.08	.106
12.91	0.28	0.82	0.76	0.54	1.09	.104
12.98	0.29	0.82	0.76	0.54	1.09	.102
13.12	0.30	0.80	0.76	0.52	1.10	.099
13.18	0.31	0.79	0.76	0.52	1.10	.097
13.25	0.32	0.78	0.76	0.51	1.10	.095
13.33	0.32	0.77	0.76	0.50	1.10	.093
13.40	0.33	0.76	0.76	0.50	1.10	.091
13.47	0.34	0.76	0.76	0.50	1.10	.090
13.54	0.34	0.75	0.76	0.49	1.11	.089
13.62	0.34	0.73	0.76	0.48	1.12	.087
13.77	0.37	0.71	0.76	0.47	1.11	.082
13.85	0.37	0.70	0.76	0.46	1.12	.081
13.92	0.38	0.69	0.77	0.45	1.11	.078
14.00	0.39	0.69	0.77	0.45	1.10	.077
14.08	0.39	0.68	0.77	0.44	1.10	.075
14.16	0.40	0.67	0.77	0.44	1.10	.074

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
14.25	0.41	0.66	0.77	0.43	1.09	.071
14.33	0.42	0.65	0.77	0.42	1.08	.069
14.41	0.43	0.64	0.77	0.42	1.08	.068
14.50	0.43	0.63	0.77	0.41	1.07	.065
14.58	0.44	0.62	0.78	0.40	1.07	.063
14.67	0.45	0.62	0.78	0.40	1.05	.061
14.75	0.46	0.61	0.78	0.39	1.05	.060
14.84	0.47	0.60	0.79	0.38	1.03	.058
14.93	0.47	0.60	0.79	0.37	1.03	.057
15.02	0.47	0.59	0.78	0.37	1.03	.056
15.10	0.49	0.57	0.79	0.36	1.01	.053
15.21	0.50	0.57	0.79	0.36	1.00	.052
15.30	0.50	0.56	0.79	0.35	0.99	.050
15.40	0.51	0.54	0.79	0.34	0.97	.048
15.49	0.52	0.53	0.80	0.33	0.95	.046
15.59	0.52	0.51	0.79	0.32	0.96	.045
15.69	0.60	0.49	0.83	0.29	0.81	.034
15.79	0.58	0.54	0.83	0.33	0.86	.040
15.89	0.58	0.52	0.83	0.32	0.85	.038
15.99	0.59	0.52	0.83	0.31	0.84	.037
16.10	0.60	0.51	0.83	0.31	0.83	.036
16.20	0.60	0.50	0.83	0.30	0.82	.035
16.30	0.61	0.49	0.83	0.29	0.80	.033
16.40	0.63	0.48	0.84	0.28	0.77	.030
16.53	0.65	0.48	0.86	0.28	0.73	.028
16.64	0.66	0.48	0.86	0.28	0.72	.028
16.75	0.67	0.47	0.86	0.27	0.71	.027
16.86	0.68	0.46	0.87	0.27	0.68	.025
16.98	0.70	0.46	0.88	0.26	0.66	.023
17.10	0.72	0.46	0.89	0.26	0.63	.022
17.21	0.73	0.46	0.89	0.26	0.62	.022
17.33	0.75	0.45	0.90	0.25	0.59	.020
17.46	0.77	0.46	0.91	0.25	0.57	.019
17.58	0.81	0.46	0.93	0.25	0.53	.017
17.71	0.84	0.48	0.95	0.25	0.51	.017
17.83	0.90	0.50	0.98	0.25	0.47	.016
17.90	1.02	0.52	1.04	0.25	0.40	.015
18.09	0.04	0.77	0.63	0.61	1.30	.105
18.23	0.65	0.30	0.83	0.18	0.58	.019
18.36	0.74	0.40	0.89	0.22	0.57	.017
18.50	0.77	0.42	0.91	0.23	0.54	.017
18.64	0.79	0.44	0.92	0.24	0.53	.017
18.78	0.81	0.44	0.93	0.24	0.52	.016
18.92	0.83	0.46	0.94	0.24	0.51	.016
19.07	0.84	0.46	0.95	0.24	0.50	.016
19.22	0.85	0.48	0.96	0.25	0.50	.016
19.37	0.86	0.48	0.96	0.25	0.49	.016
19.52	0.87	0.49	0.97	0.25	0.49	.017
19.67	0.88	0.50	0.97	0.26	0.49	.017
19.83	0.89	0.51	0.98	0.26	0.49	.017
19.99	0.89	0.52	0.98	0.27	0.49	.018
20.32	0.89	0.54	0.98	0.27	0.49	.019
20.49	0.90	0.54	0.99	0.28	0.49	.019
20.66	0.91	0.56	0.99	0.28	0.49	.019
20.83	0.91	0.57	1.00	0.29	0.50	.020
21.19	0.89	0.61	0.99	0.31	0.52	.023
21.37	0.88	0.61	0.99	0.31	0.53	.023

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
21.56	0.86	0.61	0.99	0.31	0.53	.024
21.75	0.87	0.62	0.99	0.31	0.54	.025
21.94	0.87	0.63	0.98	0.32	0.55	.025
22.13	0.86	0.63	0.98	0.32	0.55	.026
22.33	0.85	0.64	0.98	0.33	0.57	.027
22.54	0.84	0.64	0.98	0.33	0.57	.027
22.74	0.84	0.65	0.97	0.33	0.58	.028
22.95	0.82	0.65	0.97	0.34	0.59	.029
23.17	0.81	0.66	0.96	0.34	0.61	.030
23.39	0.79	0.66	0.95	0.34	0.62	.031
23.61	0.78	0.66	0.95	0.35	0.63	.031
23.84	0.75	0.66	0.94	0.35	0.65	.033
24.07	0.73	0.64	0.92	0.35	0.68	.033
24.30	0.72	0.62	0.92	0.34	0.68	.032
24.54	0.72	0.61	0.91	0.34	0.68	.032
25.04	0.71	0.60	0.91	0.33	0.69	.032
25.55	0.69	0.59	0.89	0.33	0.71	.032
25.62	0.68	0.58	0.89	0.33	0.72	.032
26.10	0.67	0.57	0.88	0.32	0.74	.033
26.37	0.67	0.55	0.88	0.32	0.74	.032
26.66	0.66	0.55	0.87	0.31	0.75	.032
26.95	0.65	0.53	0.86	0.31	0.75	.032
27.55	0.63	0.51	0.85	0.30	0.78	.033
27.86	0.61	0.49	0.84	0.29	0.80	.033
28.17	0.61	0.46	0.83	0.28	0.79	.031
28.50	0.61	0.43	0.62	0.26	0.77	.029
28.83	0.63	0.41	0.83	0.25	0.73	.027
30.00	0.65	0.37	0.84	0.22	0.66	.022

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		V
WL074	0.1-35	Refl	4.2 K for $h\nu < 4.88$ eV RT for $h\nu > 4.88$ eV			x	EP	A,R; KK: $\varepsilon_1,\varepsilon_2$, $\mathrm{Im}(\varepsilon^{-1}),\mathrm{Im}(\varepsilon+1)^{-1}$	absorption measured by calorimetry at $h\nu < 4.88$ eV, reflectivity measured for $h\nu > 4.88$ eV with synchrotron radiatio See also RCF80
CGS76	0.32-5.5	Trans, Refl		x			In	σ	
BDL77	0.03-3.1	Refl				x	MP	R	Also emissivity for $400 \leq T \leq 850$ K
GCS79	0.32-5.6	Trans, Refl		x			In	σ	ultra high vacuum film deposition
NC80	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	authors consider V values only slightly improved over JC74
NCC80	0.5-6.5	Trans, Refl		x			Ex	σ	

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		V
BVK62	0.12-0.62	Ellips				x		n,k,$\varepsilon_1,\varepsilon_2$,R	
KC65	0.05-5	Ellips				x	MP	n,k,σ	
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
Le67	0.1-4	Ellips				x	MP	ε_2/λ	data taken from LT66 and LTA66
VAK67	3-14.4					x		R	polarimetry for $3 < h\nu < 5$ eV, reflectance for $4 < h\nu < 7$ eV. and photoemission for $7.5 < h\nu < 14.4$ eV
SHK69	40-300	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
SR70	1-50	m-θ		x			Ex	R; $\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	optical constants determined by both KK analysis and two-angles of incidence technique.
SS72	0-30			x			Ex	$\mathrm{Im}(\varepsilon^{-1})$	energy loss spectroscopy
BB74			1100-1750			x		ε_N at $\lambda = 6450$ Å	
CGS74	0.32-5.5	Trans, Refl		x			In	T,σ	ultra high vacuum film deposition
JC74	0.64-6.6	Trans, Refl		x			Ex	n,k,σ	table of E,n,k
St74	0.8-4	Ellips	RT and 77			x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
WeG74	~25-130	Trans		x			Ex	μ	energy loss spectroscopy
WGa74	2-120	Trans		x				$\mu,\mathrm{Im}(\varepsilon^{-1})$; KK: $\varepsilon_1,\varepsilon_2$	energy loss spectroscopy

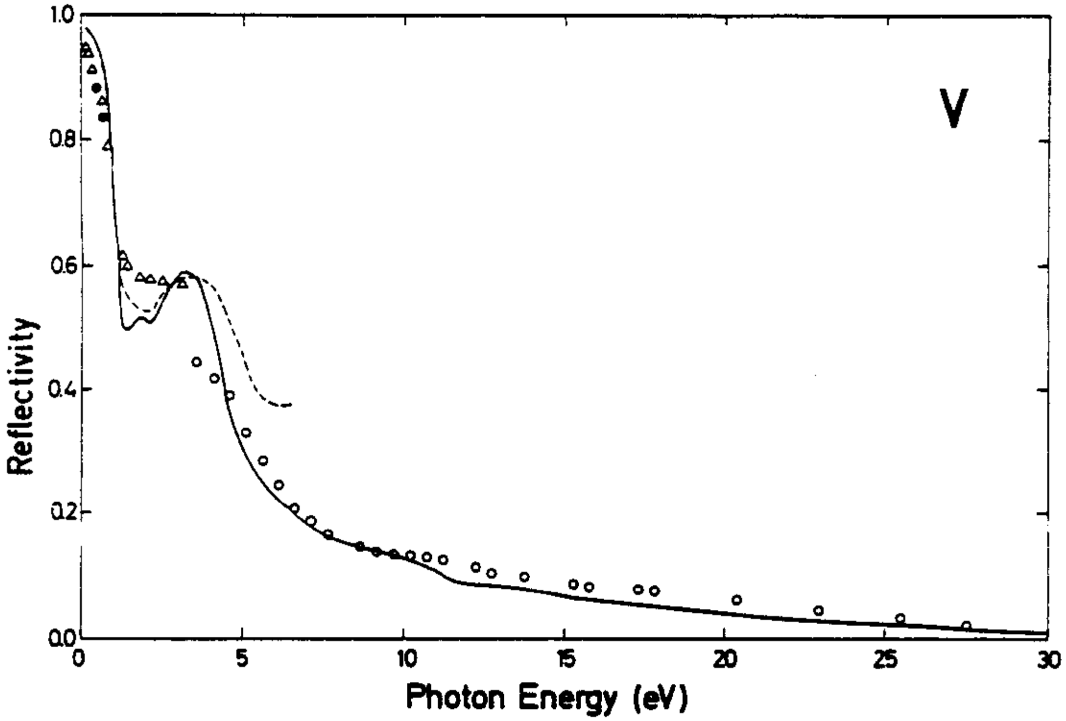

Fig. 8 Reflectivity of V. —— WL074; --- NC80; ΔΔΔ BDL77; ooo SR70; ●●● BVK62

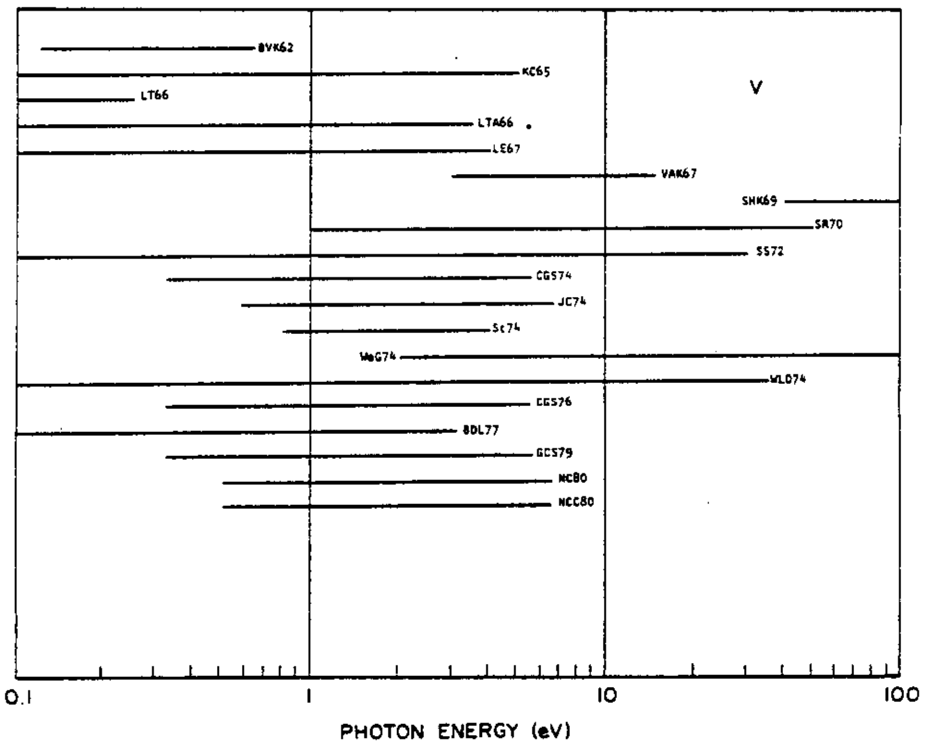

Fig. 7 Survey of available data for V

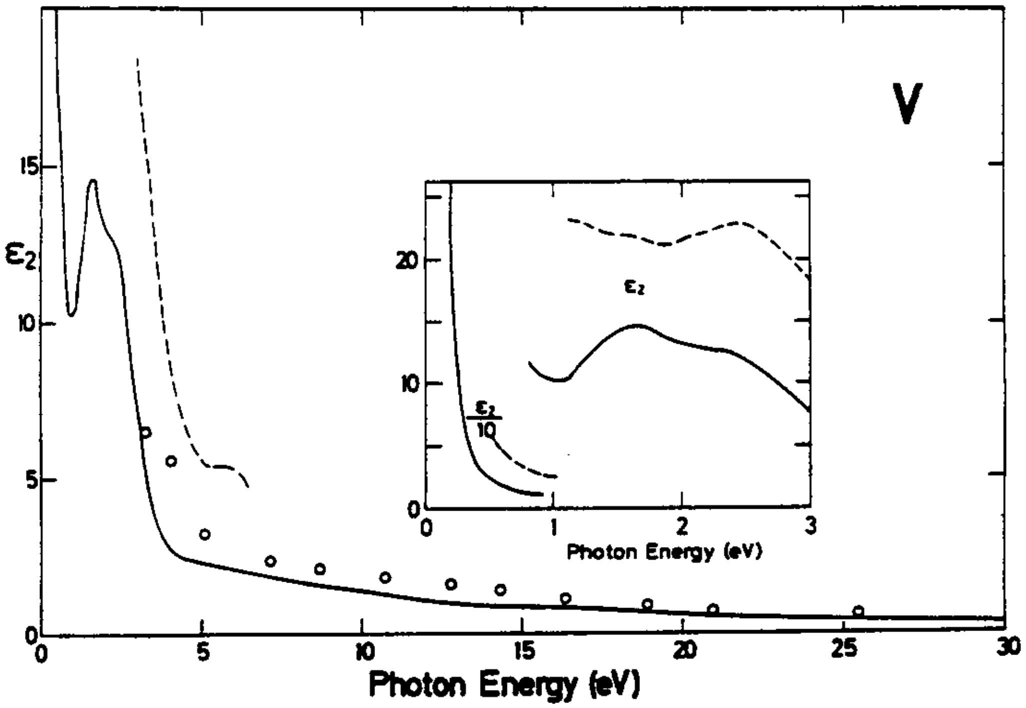

Fig. 10 ε_2 for V. —— WL074; ---NC80; ooo SR70

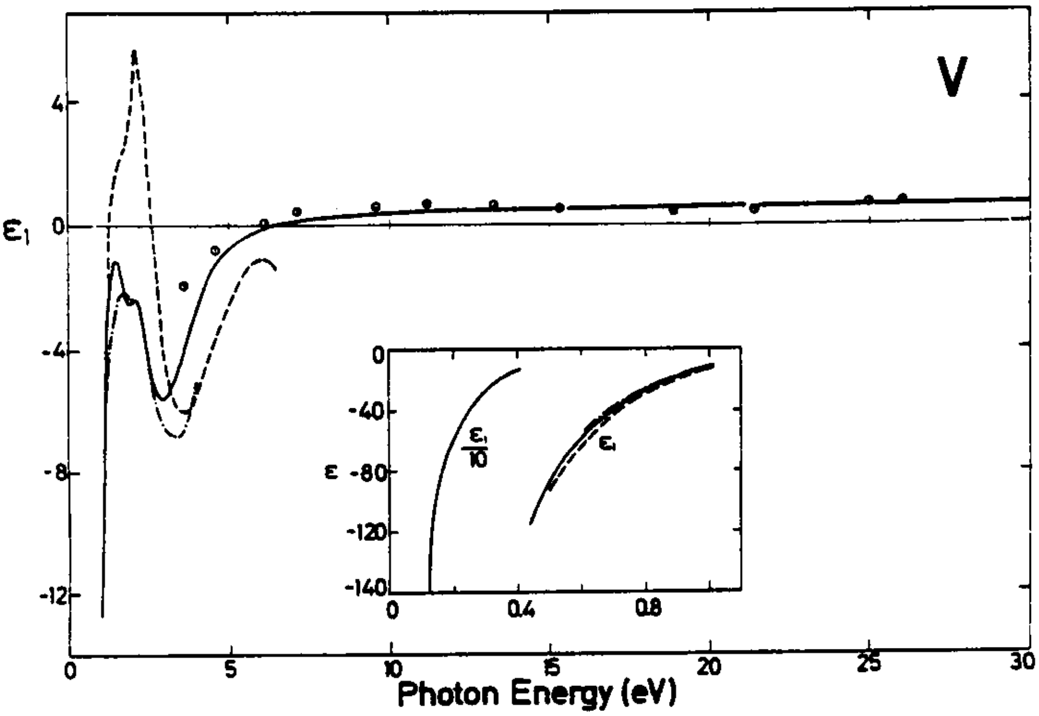

Fig. 9 ε_1 for V. —— WL074; --- NC80; -·-·- St74; ooo SR70.

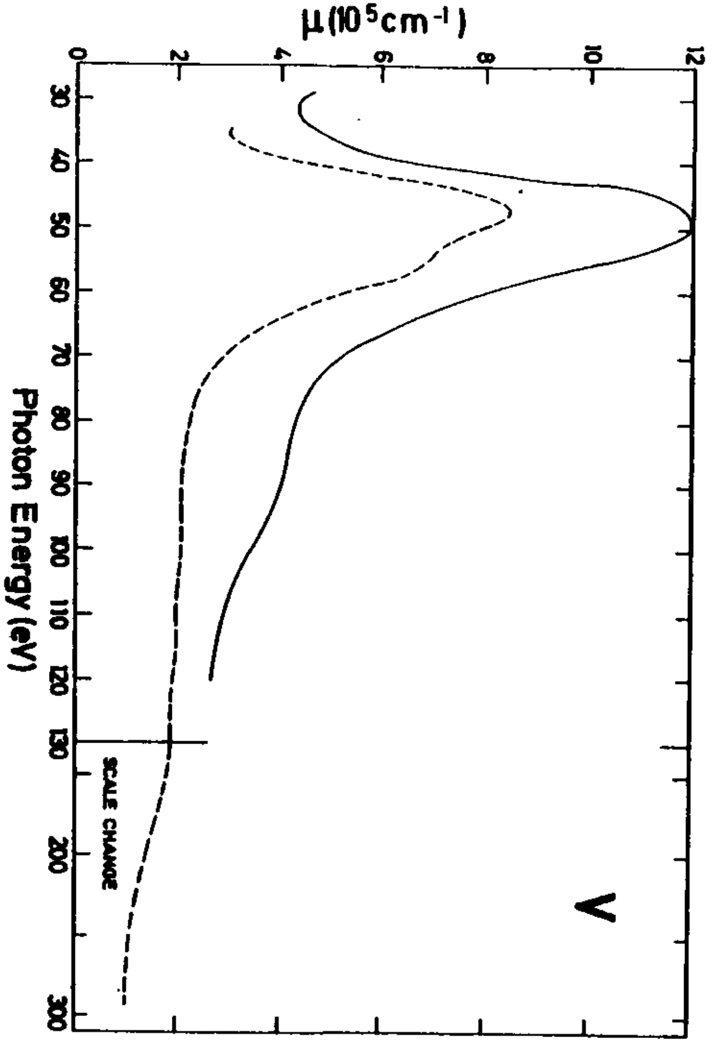

Fig. 11 Absorption coefficient for V. —— WeG74; --- SHK69.

Vanadium

publication by J.H. Weaver, D.W. Lynch, and C.G. Olson in Phys. Rev. B 10, 501 (1973) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-1941.45	1177.26	12.83	45.89	0.00	.978
0.12	-1428.27	741.24	9.51	38.97	0.00	.977
0.16	-868.69	346.81	5.77	30.03	0.00	.976
0.20	-575.21	189.43	3.90	24.30	0.00	.975
0.24	-404.94	114.63	2.82	20.32	0.00	.974
0.28	-296.58	73.93	2.13	17.35	0.00	.973
0.32	-224.17	53.98	1.79	15.08	0.00	.970
0.36	-175.15	41.04	1.54	13.32	0.00	.966
0.40	-139.72	32.91	1.38	11.90	0.00	.962
0.44	-113.70	27.59	1.28	10.74	0.00	.957
0.48	-93.94	23.32	1.19	9.77	0.00	.952
0.52	-78.42	20.64	1.16	8.93	0.00	.945
0.56	-66.29	18.30	1.11	8.22	0.00	.938
0.60	-56.47	16.74	1.10	7.59	0.00	.929
0.64	-48.48	15.00	1.07	7.04	0.01	.921
0.68	-41.63	14.04	1.07	6.54	0.01	.909
0.72	-36.01	12.90	1.06	6.09	0.01	.898
0.76	-31.03	12.28	1.08	5.67	0.01	.882
0.80	-26.91	11.70	1.10	5.30	0.01	.864
0.85	-22.53	11.17	1.14	4.88	0.02	.839
0.90	-18.83	10.63	1.18	4.50	0.02	.811
0.95	-15.52	10.30	1.25	4.13	0.03	.775
1.00	-12.64	10.22	1.34	3.80	0.04	.730
1.05	-10.19	10.26	1.46	3.51	0.05	.682
1.10	-8.06	10.42	1.60	3.26	0.06	.632
1.15	-6.18	10.69	1.76	3.04	0.07	.583
1.20	-4.59	11.10	1.93	2.88	0.08	.543
1.25	-3.31	11.61	2.09	2.77	0.08	.515
1.30	-2.29	12.21	2.25	2.71	0.08	.498
1.35	-1.62	12.88	2.38	2.70	0.08	.491
1.40	-1.24	13.50	2.48	2.72	0.07	.491
1.45	-1.14	14.02	2.54	2.76	0.07	.495
1.50	-1.18	14.36	2.57	2.79	0.07	.499
1.55	-1.32	14.56	2.58	2.82	0.07	.503
1.60	-1.46	14.64	2.57	2.84	0.07	.507
1.65	-1.72	14.65	2.55	2.87	0.07	.511
1.70	-1.94	14.51	2.52	2.88	0.07	.512
1.75	-2.11	14.32	2.49	2.88	0.07	.514
1.80	-2.29	14.10	2.45	2.88	0.07	.515
1.85	-2.43	13.81	2.41	2.87	0.07	.515
1.90	-2.56	13.44	2.36	2.85	0.07	.514
2.00	-2.42	13.14	2.34	2.81	0.07	.509
2.05	-2.37	12.92	2.32	2.78	0.07	.506
2.10	-2.40	12.86	2.31	2.78	0.08	.506
2.15	-2.47	12.81	2.30	2.79	0.08	.507
2.20	-2.64	12.77	2.28	2.80	0.08	.510
2.25	-2.84	12.68	2.25	2.81	0.08	.511
2.30	-3.02	12.60	2.23	2.83	0.08	.516
2.35	-3.34	12.52	2.19	2.86	0.07	.522

V

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
2.40	-3.68	12.36	2.15	2.88	0.07	.526
2.45	-4.07	12.10	2.09	2.90	0.07	.535
2.50	-4.36	11.77	2.02	2.91	0.07	.540
2.55	-4.67	11.43	1.96	2,92	0.07	.546
2.60	-4.95	11.07	1.89	2.92	0.08	.552
2.65	-5.14	10.56	1.81	2.91	0.08	.557
2.70	-5.33	10.10	1.74	2.89	0.08	.561
2.75	-5.46	9.64	1.68	2.88	0.08	.566
2.80	-5.53	9.19	1.61	2.85	0.08	.569
2.85	-5.60	8.76	1.55	2.83	0.08	.573
2.90	-5.65	8.29	1.48	2.80	0.08	.577
2.95	-5.62	7.85	1.42	2.76	0.08	.579
3.00	-5.59	7.43	1.36	2.73	0.09	.582
3.05	-5.53	7.00	1.30	2.69	0.09	.584
3.10	-5.43	6.61	1.25	2.64	0.09	.585
3.15	-5.32	6.23	1.20	2.60	0.09	.586
3.20	-5.17	5.90	1.16	2.55	0.10	.585
3.25	-5.04	5.59	1.12	2.51	0.10	.586
3.40	-4.63	4.71	0.99	2.37	0.11	.586
3.60	-3.94	3.76	0.87	2.17	0.13	.575
3.80	-3.18	3.13	0.80	1.96	0.16	.547
4.00	-2.50	2.76	0.78	1.76	0.20	.503
4.10	-2.20	2.63	0.78	1.68	0.22	.477
4.20	-1.92	2.55	0.80	1.60	0.25	.449
4.30	-1.70	2.48	0.81	1.53	0.27	.424
4.40	-1.49	2.43	0.83	1.47	0.30	.400
4.50	-1.30	2.40	0.85	1.42	0.32	.376
4.60	-1.14	2.38	0.87	1.38	0.34	.355
4.70	-1.01	2.38	0.89	1.34	0.36	.338
4.80	-0.92	2.36	0.90	1.31	0.37	.326
4.90	-0.82	2.33	0.91	1.28	0.38	.313
5.00	-0.75	2.29	0.91	1.26	0.39	.304
5.04	-0.72	2.27	0.91	1.25	0.40	.299
5.10	-0.66	2.25	0.92	1.23	0.41	.291
5.16	-0.61	2.23	0.92	1.21	0.42	.285
5.23	-0.56	2.21	0.93	1.19	0.42	.277
5.30	-0.51	2.19	0.93	1.18	0.43	.271
5.37	-0.45	2.18	0.94	1.15	0.44	.262
5.44	-0.40	2.18	0.95	1.14	0.44	.256
5.51	-0.42	2.15	0.94	1.14	0.45	.250
5.58	-0.33	2.11	0.95	1.11	0.46	.245
5.66	-0.29	2.11	0.96	1.10	0.46	.240
5.74	-0.25	2.10	0.96	1.09	0.47	.235
5.82	-0.23	2.09	0.97	1.08	0.47	.231
5.90	-0.18	2.07	0.97	1.06	0.48	.225
5.98	-0.17	2.07	0.98	1.06	0.48	.223
6.08	-0.14	2.04	0.98	1.05	0.49	.219
6.17	-0.12	2.02	0.98	1.04	0.49	.216
6.26	-0.10	1.99	0.97	1.02	0.50	.212
6.36	-0.08	1.96	0.97	1.01	0.51	.208
6.46	-0.04	1.93	0.97	0.99	0.52	.202
6.60	-0.03	1.90	0.97	0.98	0.53	.194
6.65	0.00	1.87	0.97	0.97	0.53	.194
6.77	0.04	1.85	0.97	0.95	0.54	.189
6.88	0.06	1.83	0.97	0.94	0.55	.185
7.00	0.10	1.80	0.98	0.92	0.55	.179
7.17	0.13	1.79	0.98	0.91	0.56	.175

V

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
7.38	0.15	1.74	0.97	0.89	0.57	.170
7.51	0.19	1.71	0.98	0.87	0.58	.164
7.65	0.19	1.70	0.98	0.87	0.58	.162
7.79	0.23	1.67	0.98	0.85	0.59	.156
7.95	0.23	1.65	0.98	0.85	0.59	.155
8.10	0.25	1.62	0.97	0.83	0.60	.152
8.26	0.29	1.59	0.98	0.81	0.61	.146
8.43	0.31	1.59	0.98	0.81	0.61	.143
8.61	0.29	1.59	0.98	0.81	0.61	.145
8.79	0.29	1.56	0.97	0.81	0.62	.144
8.98	0.28	1.52	0.96	0.79	0.64	.142
9.16	0.29	1.48	0.95	0.78	0.65	.139
9.46	0.29	1.44	0.94	0.77	0.67	.136
9.68	0.29	1.40	0.93	0.75	0.68	.134
9.92	0.28	1.35	0.91	0.74	0.71	.133
10.08	0.31	1.31	0.91	0.72	0.72	.127
10.42	0.29	1.26	0.89	0.71	0.75	.126
10.69	0.30	1.19	0.88	0.68	0.79	.120
10.97	0.33	1.13	0.87	0.65	0.82	.112
11.27	0.37	1.07	0.87	0.62	0.83	.102
11.59	0.44	1.03	0.88	0.58	0.82	.091
11.92	0.47	1.04	0.90	0.58	0.80	.088
12.04	0.47	1.05	0.90	0.58	0.80	.089
12.28	0.46	1.03	0.89	0.58	0.81	.089
12.46	0.47	1.01	0.89	0.57	0.81	.086
12.58	0.47	1.01	0.89	0.57	0.82	.086
12.72	0.47	0.99	0.88	0.56	0.82	.085
12.92	0.47	0.98	0.88	0.55	0.83	.083
13.05	0.47	0.97	0.88	0.55	0.83	.082
13.19	0.47	0.96	0.88	0.55	0.84	.083
13.33	0.47	0.94	0.87	0.54	0.85	.080
13.48	0.47	0.93	0.87	0.53	0.85	.079
13.62	0.48	0.92	0.87	0.53	0.86	.079
13.78	0.48	0.90	0.87	0.52	0.87	.077
13.93	0.48	0.89	0.86	0.51	0.87	.075
14.09	0.49	0.87	0.86	0.50	0.87	.074
14.25	0.50	0.86	0.86	0.50	0.87	.071
14.42	0.50	0.85	0.86	0.49	0.87	.071
14.59	0.50	0.84	0.86	0.49	0.88	.070
14.76	0.50	0.83	0.86	0.48	0.88	.069
14.94	0.51	0.81	0.86	0.47	0.89	.067
15.02	0.52	0.80	0.86	0.47	0.88	.065
15.30	0.52	0.80	0.86	0.46	0.88	.064
15.50	0.53	0.78	0.86	0.46	0.88	.062
15.70	0.53	0.78	0.86	0.45	0.88	.062
15.90	0.53	0.77	0.85	0.45	0.89	.061
16.10	0.53	0.75	0.85	0.44	0.89	.060
16.31	0.52	0.74	0.85	0.44	0.90	.060
16.53	0.53	0.73	0.84	0.43	0.90	.059
16.87	0.53	0.71	0.84	0.42	0.91	.057
17.10	0.53	0.69	0.84	0.41	0.91	.056
17.34	0.53	0.68	0.83	0.41	0.92	.055
17.59	0.53	0.66	0.83	0.40	0.92	.054
17.84	0.53	0.64	0.83	0.39	0.93	.052
18.10	0.54	0.63	0.82	0.38	0.92	.051
18.37	0.54	0.62	0.82	0.37	0.92	.049
18.64	0.54	0.60	0.82	0.37	0.92	.048

V

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(ϕ=0)
18.78	0.54	0.59	0.82	0.36	0.92	.047
19.07	0.55	0.57	0.82	0.35	0.91	.045
19.37	0.55	0.56	0.82	0.34	0.90	.044
19.68	0.55	0.55	0.82	0.34	0.90	.043
19.83	0.55	0.54	0.81	0.33	0.90	.042
20.00	0.56	0.52	0.81	0.32	0.90	.041
20.15	0.56	0.52	0.81	0.32	0.89	.040
20.32	0.56	0.51	0.81	0.31	0.88	.039
20.49	0.57	0.50	0.81	0.31	0.87	.038
20.66	0.57	0.49	0.81	0.30	0.87	.038
20.84	0.57	0.49	0.81	0.30	0.86	.036
21.01	0.58	0.48	0.81	0.29	0.85	.036
21.19	0.58	0.47	0.81	0.29	0.85	.035
21.38	0.58	0.46	0.81	0.28	0.83	.034
21.56	0.59	0.46	0.81	0.28	0.83	.033
21.75	0.59	0.45	0.82	0.28	0.82	.032
21.94	0.59	0.44	0.81	0.27	0.81	.032
22.14	0.59	0.43	0.81	0.27	0.81	.032
22.34	0.59	0.42	0.81	0.26	0.80	.031
22.54	0.60	0.41	0.81	0.25	0.78	.029
22.75	0.60	0.40	0.81	0.25	0.76	.028
22.96	0.61	0.40	0.82	0.24	0.75	.027
23.17	0.61	0.39	0.82	0.24	0.74	.026
23.39	0.62	0.38	0.82	0.23	0.72	.025
23.61	0.62	0.38	0.82	0.23	0.71	.025
23.84	0.63	0.37	0.82	0.22	0.70	.024
24.07	0.63	0.36	0.82	0.22	0.68	.023
24.30	0.63	0.35	0.82	0.21	0.67	.023
24.55	0.64	0.35	0.83	0.21	0.66	.022
24.80	0.64	0.34	0.83	0.20	0.64	.021
25.05	0.65	0.33	0.83	0.20	0.62	.020
25.20	0.65	0.33	0.83	0.20	0.62	.020
25.50	0.66	0.32	0.83	0.19	0.60	.019
25.60	0.66	0.32	0.83	0.19	0.59	.019
25.80	0.66	0.31	0.83	0.19	0.58	.018
26.00	0.66	0.31	0.83	0.18	0.57	.018
26.20	0.67	0.30	0.84	0.18	0.56	.017
26.40	0.67	0.29	0.84	0.18	0.55	.017
26.60	0.67	0.29	0.84	0.17	0.54	.016
26.80	0.68	0.28	0.84	0.17	0.52	.016
27.00	0.68	0.28	0.84	0.16	0.51	.015
27.20	0.69	0.27	0.84	0.16	0.50	.015
27.40	0.69	0.27	0.85	0.16	0.49	.014
27.60	0.69	0.26	0.85	0.16	0.48	.014
27.80	0.70	0.26	0.85	0.15	0.47	.013
28.00	0.70	0.26	0.85	0.15	0.46	.013
28.50	0.71	0.25	0.86	0.14	0.44	.012
29.00	0.72	0.24	0.86	0.14	0.41	.011
29.50	0.73	0.23	0.86	0.13	0.39	.010
30.00	0.73	0.22	0.87	0.13	0.37	.009
30.50	0.75	0.21	0.87	0.12	0.35	.009
31.00	0.75	0.20	0.88	0.12	0.33	.008
31.50	0.76	0.20	0.88	0.11	0.32	.007
32.00	0.77	0.19	0.89	0.11	0.30	.007
32.50	0.79	0.18	0.89	0.10	0.28	.006
33.00	0.80	0.18	0.90	0.10	0.26	.005
33.50	0.81	0.17	0.91	0.10	0.25	.005

V

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(ϕ=0)
34.00	0.82	0.18	0.91	0.10	0.25	.005
34.50	0.83	0.18	0.92	0.10	0.24	.004
35.00	0.84	0.17	0.92	0.09	0.24	.004
35.50	0.86	0.18	0.93	0.09	0.23	.004
36.00	0.87	0.18	0.94	0.10	0.23	.004
36.50	0.87	0.19	0.94	0.10	0.24	.004
37.00	0.88	0.19	0.94	0.10	0.24	.004
37.50	0.89	0.20	0.95	0.11	0.24	.004
38.00	0.89	0.21	0.95	0.11	0.25	.004
38.50	0.89	0.22	0.95	0.11	0.26	.004
39.00	0.89	0.22	0.95	0.12	0.26	.004
39.50	0.89	0.23	0.95	0.12	0.28	.004
40.00	0.89	0.24	0.95	0.13	0.28	.005

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Cr
				Film	X-tal	Bulk	Prep		
SS72	0-30			x			Ex	$\mathrm{Im}(\varepsilon^{-1})$	energy loss spectroscopy
Ud72	1-12	Refl				x	EP	R; KK: ε_2	
JC74	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	table of E,n,k
St74	0.8-4	Ellips				x	EP	$\varepsilon_2/\lambda,\varepsilon_1$	
WGa74	2-120	Trans		x			Ex	$\mu,\mathrm{Im}(\varepsilon^{-1})$; KK: $\varepsilon_1,\varepsilon_2$	energy loss spectroscopy
WeG74	2-130	Trans		x			Ex	KK: μ	energy loss spectroscopy
FLS75	0.08-4.13	Refl		x			Ex	R; KK: n,k	
KIN75	0.058-4.9	Ellips	100-430			x	EP	σ	Cr and Cr-Fe alloys; EP and annealed at 973
KN75	0.07-4.1	Ellips	295			x	MP	$\varepsilon_1,\varepsilon_2$,R,$\sigma$,n,k	annealed 10^{-6} Torr, 1073 K
ST77	0.05-0.10	Ellips	295		x		MP	$\varepsilon_2/\lambda,\varepsilon_1$	
GCS79	0.32-5.6	Trans, Refl		x			In	σ	uhv deposition
NC80	0.5-6.5	Trans, Refl				x	Ex	n,k	authors consider Cr values significantly improved over results of JC74; substrate at 700°C during deposition
NCC80	0.5-6.5	Trans, Refl		x				σ	
OL Unpl	4-30	Refl				x	EP	R; KK: $\varepsilon_1,\varepsilon_2,\sigma$, $\mathrm{Im}(\varepsilon^{-1}),\mu$	synchrotron radiation

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Cr
				Film	X-tal	Bulk	Prep		
Sa39	2.6-27.6	Refl		x			Ex	R	
LSE64	109-539	Trans		x				μ	
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
HL67	0.01-.5	Trans, Refl	RT, 107			x		R	
Le67	0.6-4	Ellips				x	MP	ε_2/λ	data from LT66 and LTA66
BHR68	0.62-2.5	Refl	80, 156, 200, 300		x		EP	R^3; KK: σ	
GL68	2-5.6	m-θ				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
GSP68	4-40	m-θ	300, 623	x			Ex	R,$\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	plotted data is at RT, two angles incidence
KN68	0.07-5	Ellips	293,420			x	MP	n,k,σ	mechanically polished plus 450°C anneal at 10^{-6} Torr
MS69	0.5-2.4					x	MP	R	absorption measured by calorimetry; Cr and Cr-Fe
SHK69	40-300	Trans		x			Ex	μ	optical absorption measurements
BD70	0.038-1.65	Refl	80, 300		x		EP	KK: n,k	plotted data is at 300 K
BL70	0.08-5	Refl	4.2		x		EP	A,R; KK: ε_2,σ	absorptivity measured by calorimetry
JPT72	∿0.08-∿0.48	Refl	7.5 and 281			x		A	reflectivities measured relative to Au fil
LS72	∿0.05-1.0	Refl	30		x			R	

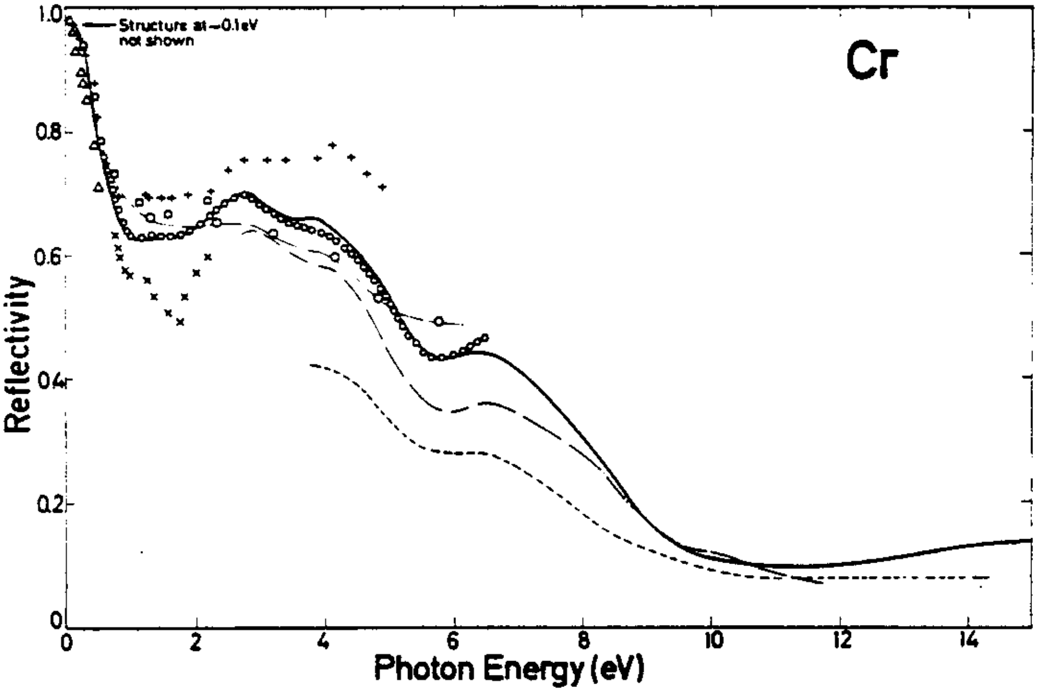

Fig. 13 Reflectivity of Cr. —— BL70 and OL (unpub); +++ KN68; --- GSP68; ooo NC80; ΔΔΔ HL68; □□□ BD70; xxx MS69; o-o-o FLS75; — • — Ud72.

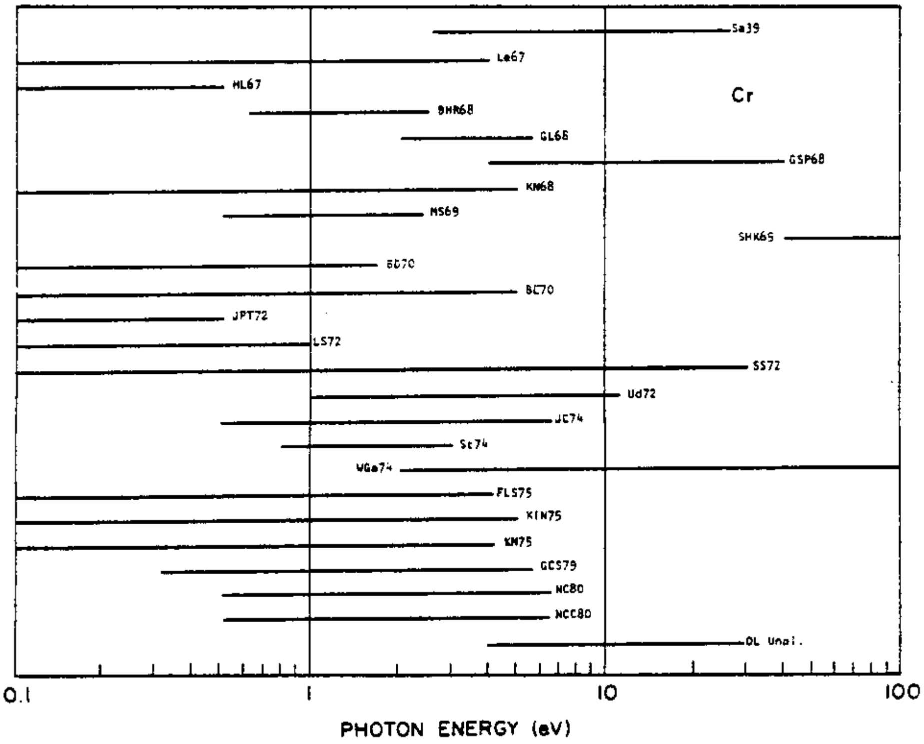

Fig. 12 Survey of available data for Cr

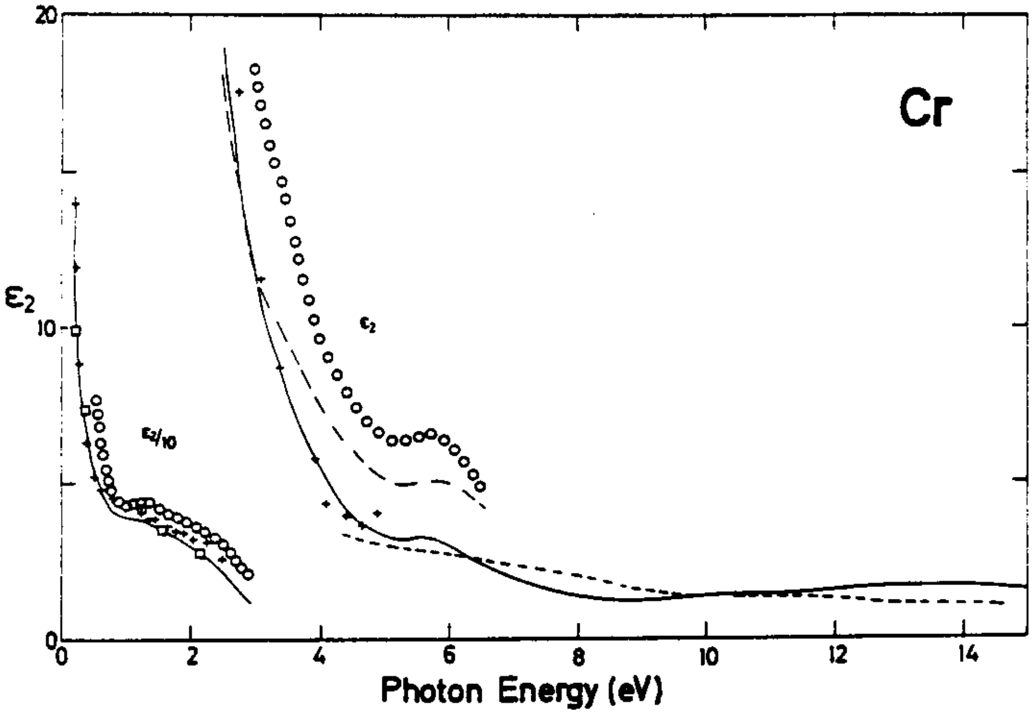

Fig. 15 ε_2 for Cr. —— BL70 and OL (unpub); +++ KN68; --- GSP68; ooo NC80; □□□ BD70; — — — JC75.

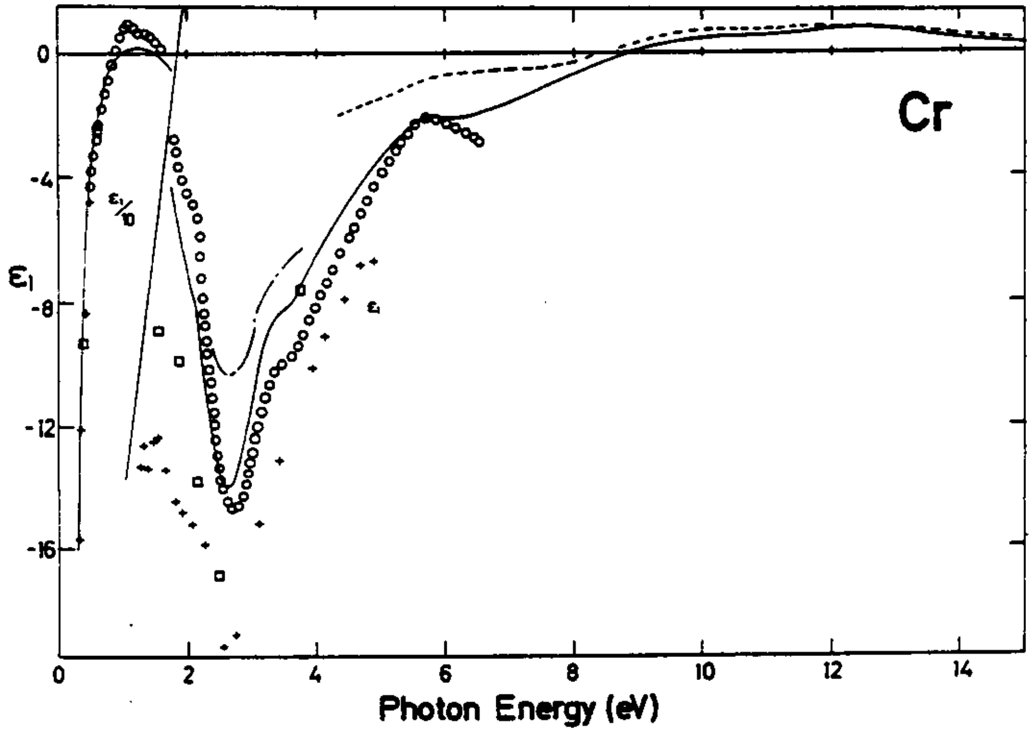

Fig. 14 ε_1 for Cr. —— BL70 and OL (unpub); +++ KN68; --- GSP68; ooo NC80; □□□ BD70; — - — St74.

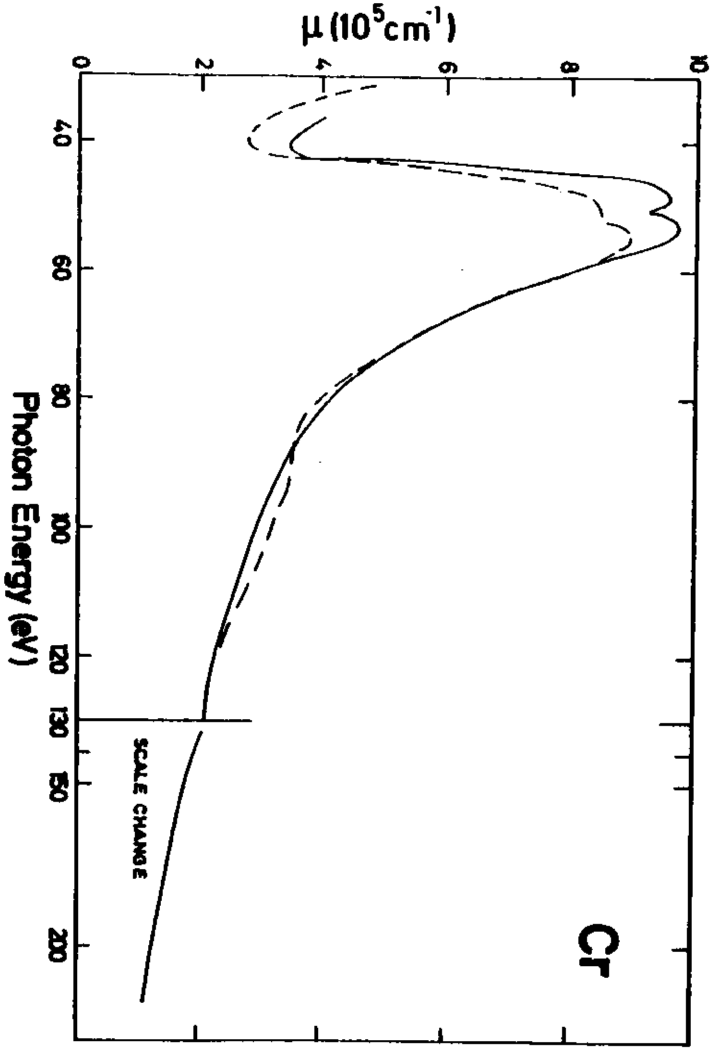

Fig. 16 Absorption coefficient for Cr. —— SHK69; --- WeG74.

Chromium

composite tabulation from L.W. Bos and D.W. Lynch, Phys. Rev. B 2, 4567 (1970) and C.G. Olson and D.W. Lynch (unpub)

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.04	-4030.87	1948.49	14.94	65.22	0.00	.987
0.06	-1315.04	1779.84	21.19	42.00	0.00	.962
0.08	-1596.85	1149.44	13.61	42.22	0.00	.973
0.09	-1008.58	799.00	11.79	33.88	0.00	.964
0.10	-746.14	703.19	11.81	29.76	0.00	.955
0.14	-460.80	807.03	15.31	26.36	0.00	.936
0.18	-567.33	442.84	8.73	25.37	0.00	.953
0.22	-396.98	218.52	5.30	20.62	0.00	.954
0.26	-277.90	133.99	3.91	17.12	0.00	.951
0.30	-194.05	89.98	3.15	14.28	0.00	.943
0.34	-134.94	69.15	2.89	11.97	0.00	.927
0.38	-93.86	62.88	3.09	10.17	0.00	.897
0.42	-68.40	62.16	3.47	8.97	0.01	.862
0.46	-53.41	61.09	3.72	8.20	0.01	.834
0.50	-42.84	58.00	3.83	7.58	0.01	.811
0.54	-34.39	55.36	3.92	7.06	0.01	.788
0.58	-28.11	53.35	4.01	6.65	0.01	.769
0.62	-23.77	50.70	4.01	6.31	0.02	.753
0.66	-19.79	47.14	3.96	5.95	0.02	.736
0.70	-15.17	44.79	4.01	5.59	0.02	.715
0.74	-11.55	43.04	4.06	5.30	0.02	.697
0.78	-8.26	41.58	4.13	5.03	0.02	.680
0.82	-5.18	40.73	4.24	4.81	0.02	.665
0.86	-2.84	40.56	4.35	4.66	0.02	.655
0.90	-1.50	40.75	4.43	4.60	0.02	.650
0.92	-1.01	40.57	4.45	4.56	0.02	.647
0.96	-0.24	40.24	4.47	4.50	0.02	.644
1.00	0.43	39.59	4.47	4.43	0.03	.639
1.04	1.34	39.35	4.51	4.36	0.03	.635
1.08	1.71	39.28	4.53	4.34	0.03	.633
1.12	1.99	39.06	4.53	4.31	0.03	.631
1.16	2.09	38.94	4.53	4.30	0.03	.631
1.20	2.06	38.75	4.52	4.29	0.03	.630
1.24	1.97	38.53	4.50	4.28	0.03	.629
1.28	1.84	38.36	4.49	4.28	0.03	.629
1.32	1.50	38.34	4.47	4.29	0.03	.630
1.36	1.05	38.05	4.42	4.30	0.03	.631
1.40	0.58	37.75	4.38	4.31	0.03	.631
1.44	0.14	37.38	4.33	4.32	0.03	.632
1.46	-0.10	37.23	4.31	4.32	0.03	.632
1.50	-0.54	36.93	4.27	4.33	0.03	.633
1.52	-0.91	36.66	4.23	4.34	0.03	.633
1.77	-4.37	33.53	3.84	4.37	0.03	.639
2.03	-6.86	30.36	3.48	4.36	0.03	.644
2.13	-8.04	29.21	3.34	4.38	0.03	.649
2.22	-9.38	28.02	3.18	4.41	0.03	.656
2.33	-10.93	26.51	2.94	4.45	0.03	.666
2.42	-12.38	24.53	2.75	4.46	0.03	.677
2.53	-13.54	22.14	2.49	4.44	0.03	.688

Cr

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
2.63	-14.10	19.39	2.22	4.36	0.03	.698
2.72	-13.86	16.78	1.99	4.22	0.04	.703
2.83	-13.22	14.65	1.80	4.06	0.04	.703
2.92	-12.39	12.67	1.65	3.89	0.04	.701
3.03	-11.39	11.47	1.54	3.71	0.04	.695
3.13	-10.39	10.46	1.48	3.54	0.05	.684
3.22	-9.47	9.82	1.44	3.40	0.05	.670
3.33	-8.87	9.46	1.43	3.31	0.06	.660
3.42	-8.59	9.03	1.39	3.24	0.06	.657
3.53	-8.37	8.48	1.33	3.18	0.06	.658
3.63	-8.14	7.84	1.26	3.12	0.06	.661
3.72	-7.81	7.18	1.18	3.04	0.06	.661
3.83	-7.42	6.59	1.12	2.95	0.07	.660
3.92	-7.01	6.06	1.06	2.85	0.07	.657
4.03	-6.57	5.61	1.02	2.76	0.08	.651
4.13	-6.18	5.23	0.98	2.67	0.08	.646
4.22	-5.78	4.86	0.94	2.58	0.09	.639
4.32	-5.38	4.55	0.91	2.49	0.09	.630
4.40	-5.06	4.37	0.90	2.42	0.10	.620
4.50	-4.72	4.20	0.89	2.35	0.11	.607
4.60	-4.43	4.00	0.88	2.28	0.11	.598
4.70	-4.12	3.80	0.86	2.21	0.12	.586
4.80	-3.82	3.66	0.86	2.13	0.13	.572
4.90	-3.54	3.54	0.86	2.07	0.14	.557
5.00	-3.29	3.43	0.85	2.01	0.15	.542
5.10	-3.03	3.35	0.86	1.94	0.16	.523
5.21	-2.75	3.27	0.87	1.87	0.18	.503
5.30	-2.53	3.27	0.90	1.83	0.19	.482
5.39	-2.38	3.34	0.93	1.80	0.20	.466
5.51	-2.22	3.33	0.94	1.76	0.21	.452
5.61	-2.12	3.33	0.95	1.74	0.21	.443
5.71	-2.11	3.38	0.97	1.75	0.21	.440
5.79	-2.07	3.37	0.97	1.74	0.22	.437
5.90	-2.06	3.33	0.96	1.73	0.22	.437
5.99	-2.12	3.26	0.94	1.73	0.22	.444
6.11	-2.11	3.16	0.92	1.72	0.22	.446
6.20	-2.07	3.02	0.89	1.69	0.23	.446
6.29	-2.04	2.94	0.88	1.68	0.23	.446
6.39	-2.02	2.83	0.85	1.65	0.23	.447
6.49	-1.97	2.67	0.82	1.63	0.24	.449
6.60	-1.89	2.56	0.80	1.59	0.25	.444
6.70	-1.84	2.45	0.78	1.57	0.26	.444
6.81	-1.72	2.27	0.75	1.51	0.28	.439
6.89	-1.64	2.25	0.76	1.49	0.29	.429
7.01	-1.57	2.14	0.74	1.45	0.30	.425
7.13	-1.49	2.03	0.72	1.42	0.32	.421
7.21	-1.42	1.96	0.71	1.39	0.33	.414
7.29	-1.36	1.99	0.70	1.36	0.35	.410
7.38	-1.29	1.82	0.69	1.33	0.37	.404
7.52	-1.17	1.70	0.67	1.27	0.40	.392
7.61	-1.06	1.63	0.66	1.23	0.43	.378
7.70	-0.96	1.58	0.67	1.19	0.46	.363
7.80	-0.87	1.54	0.67	1.15	0.49	.347
7.90	-0.77	1.50	0.68	1.11	0.53	.330
8.00	-0.69	1.47	0.68	1.07	0.56	.315
8.10	-0.59	1.44	0.69	1.04	0.60	.296
8.21	-0.50	1.42	0.71	1.00	0.63	.278

Cr

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
8.32	-0.42	1.40	0.72	0.97	0.66	.261
8.49	-0.29	1.37	0.74	0.92	0.70	.235
8.61	-0.21	1.36	0.76	0.89	0.72	.218
8.73	-0.14	1.36	0.78	0.87	0.73	.204
8.92	-0.04	1.34	0.81	0.83	0.75	.184
9.05	0.04	1.34	0.83	0.81	0.75	.170
9.25	0.15	1.33	0.86	0.77	0.74	.151
9.54	0.29	1.36	0.92	0.74	0.70	.132
9.76	0.37	1.39	0.95	0.73	0.67	.124
10.00	0.43	1.43	0.98	0.73	0.64	.120
10.25	0.48	1.44	1.00	0.72	0.63	.115
10.51	0.52	1.45	1.01	0.72	0.61	.112
10.78	0.57	1.45	1.03	0.70	0.60	.107
11.07	0.62	1.46	1.05	0.69	0.58	.103
11.27	0.68	1.47	1.07	0.69	0.56	.100
11.48	0.71	1.50	1.09	0.69	0.55	.100
11.70	0.74	1.52	1.10	0.69	0.53	.100
12.04	0.78	1.57	1.13	0.70	0.51	.101
12.28	0.79	1.62	1.14	0.71	0.50	.104
12.53	0.79	1.68	1.15	0.73	0.49	.108
12.78	0.76	1.73	1.15	0.75	0.48	.113
13.05	0.72	1.78	1.15	0.77	0.48	.119
13.33	0.65	1.80	1.13	0.80	0.49	.125
13.48	0.61	1.80	1.12	0.80	0.50	.128
13.78	0.54	1.79	1.10	0.82	0.51	.133
13.93	0.51	1.78	1.09	0.82	0.52	.135
14.25	0.44	1.74	1.06	0.82	0.54	.139
14.59	0.38	1.70	1.03	0.82	0.56	.142
14.76	0.36	1.67	1.01	0.82	0.57	.142
14.94	0.33	1.63	1.00	0.82	0.59	.143
15.31	0.31	1.56	0.97	0.80	0.62	.141
15.50	0.29	1.53	0.96	0.80	0.63	.141
15.70	0.28	1.50	0.95	0.79	0.65	.141
16.10	0.27	1.42	0.92	0.77	0.68	.139
16.32	0.26	1.39	0.92	0.76	0.70	.137
16.53	0.27	1.36	0.91	0.75	0.71	.134
16.76	0.27	1.33	0.90	0.74	0.72	.133
16.99	0.27	1.31	0.90	0.73	0.73	.132
17.22	0.27	1.29	0.89	0.72	0.75	.131
17.46	0.27	1.26	0.86	0.72	0.76	.130
17.71	0.25	1.24	0.87	0.71	0.77	.129
17.97	0.25	1.22	0.87	0.70	0.79	.129
18.24	0.24	1.20	0.85	0.70	0.80	.130
18.51	0.23	1.17	0.84	0.69	0.83	.130
18.79	0.22	1.14	0.83	0.68	0.85	.130
19.08	0.21	1.10	0.82	0.68	0.88	.131
19.38	0.20	1.07	0.80	0.67	0.91	.132
19.66	0.19	1.02	0.78	0.65	0.95	.131
20.00	0.19	0.98	0.77	0.64	0.99	.130
20.33	0.19	0.93	0.75	0.62	1.03	.127
20.67	0.20	0.89	0.74	0.60	1.07	.124
21.02	0.21	0.85	0.74	0.58	1.11	.121
21.38	0.22	0.82	0.73	0.56	1.15	.117
21.75	0.22	0.78	0.72	0.54	1.19	.115
22.14	0.23	0.74	0.71	0.52	1.23	.112
22.55	0.24	0.70	0.70	0.50	1.28	.109
22.96	0.25	0.66	0.69	0.48	1.33	.105

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Mn
				Film	X-tal	Bulk	Prep		
Sa39	2.6-27.6	Refl		x			Ex	R	
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda, -\varepsilon_1$	
SHK69	40-300	Trans		x			Ex	μ	optical absorption with synchrotron radiation
JC74	0.64-6.6	Trans, Refl		x			Ex	n, k, σ	table of E,n,k
St74	0.8-4	Ellips				x	MP	$\varepsilon_2/\lambda, \varepsilon_1$	
WeG74	2-130	Trans		x			Ex	KK: μ	energy loss spectroscopy
WGa74	2-120	Trans		x			Ex	$\mu, \mathrm{Im}(\varepsilon^{-1})$; KK: $\varepsilon_1, \varepsilon_2$	energy loss spectroscopy

Cr

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(φ=0)
23.40	0.26	0.62	0.68	0.45	1.38	.101
23.85	0.28	0.57	0.68	0.43	1.42	.096
24.31	0.30	0.53	0.67	0.39	1.43	.089
24.80	0.33	0.49	0.68	0.36	1.42	.080
25.31	0.35	0.45	0.68	0.33	1.36	.072
25.83	0.39	0.43	0.70	0.31	1.27	.063
26.38	0.42	0.40	0.71	0.28	1.18	.055
26.96	0.45	0.38	0.72	0.26	1.09	.049
27.56	0.48	0.36	0.73	0.25	1.01	.043
28.18	0.51	0.35	0.75	0.23	0.91	.037
28.84	0.54	0.34	0.77	0.22	0.83	.032
29.52	0.56	0.33	0.78	0.21	0.78	.030

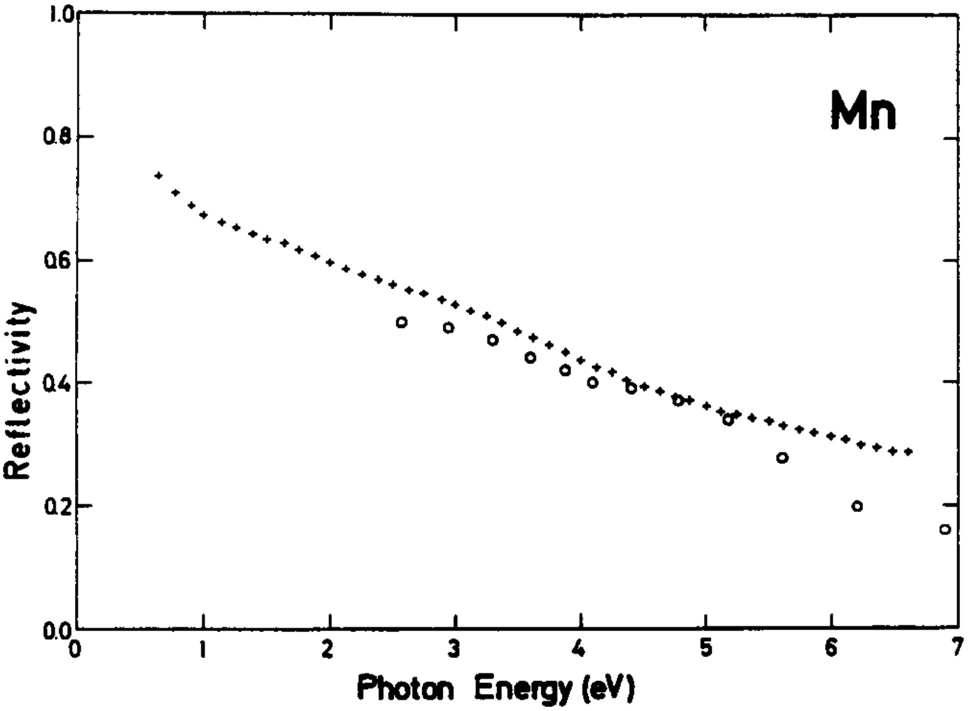

Fig. 18 Reflectivity of Mn. +++ JC74; ooo Sa39.

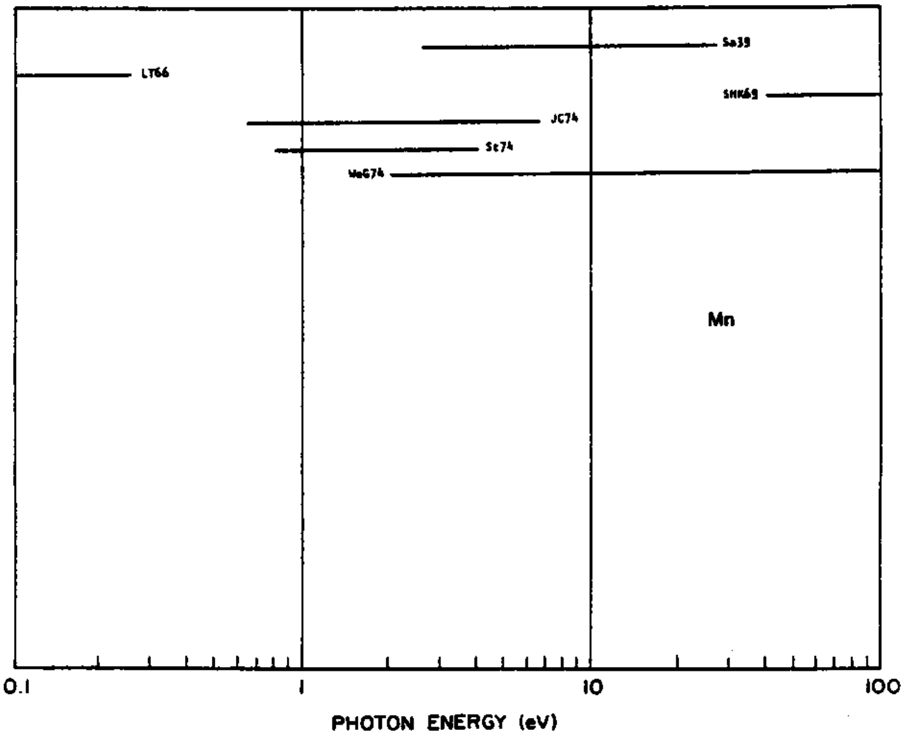

Fig. 17 Survey of available data for Mn

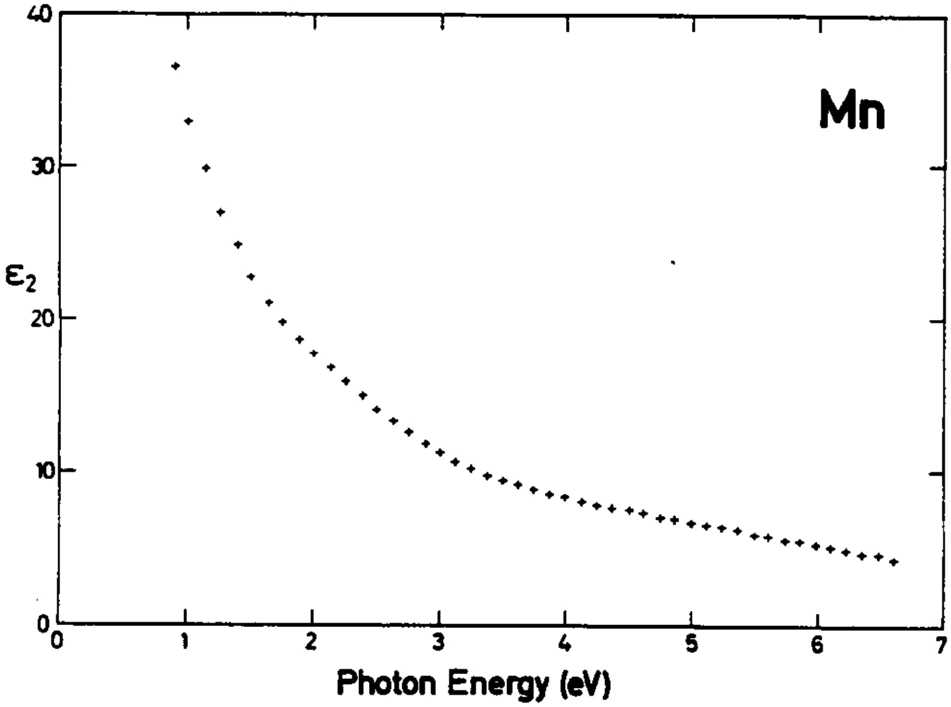

Fig. 20 ε_2 for Mn. +++ JC74.

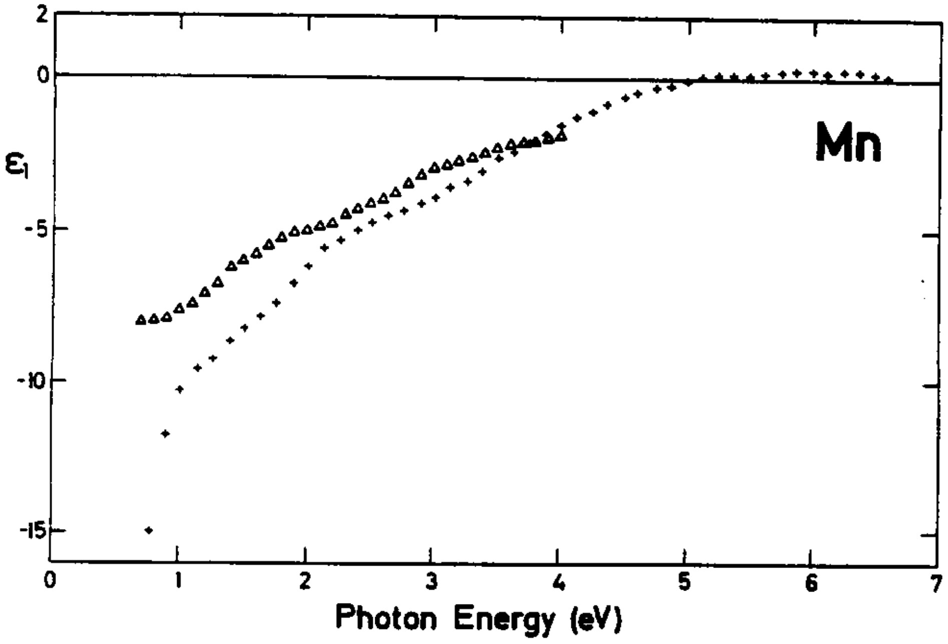

Fig. 19 ε_1 for Mn. +++ JC74; ΔΔΔ St74.

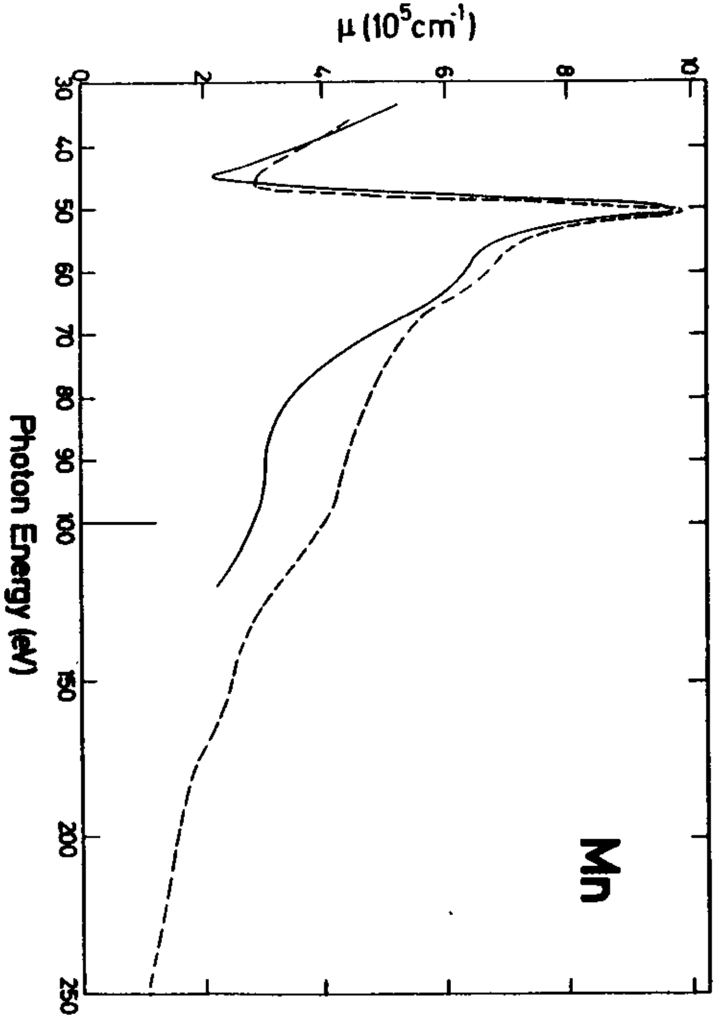

Fig. 21 Absorption coefficient for Mn. —— WeG74; --- SHK69.

Manganese

data from P.B. Johnson and R.W. Christy, Phys. Rev. B 9, 5056 (1974)

Energy (eV)	ε_1	ε_2	n	k	Im(-1/$\tilde{\varepsilon}$)	R(ϕ=0)
0.64	-20.27	46.29	3.89	5.95	0.02	.738
0.77	-14.98	40.90	3.78	5.41	0.02	.710
0.89	-11.88	36.65	3.65	5.02	0.02	.688
1.02	-10.36	32.99	3.48	4.74	0.03	.673
1.14	-9.63	29.90	3.30	4.53	0.03	.662
1.26	-9.31	26.97	3.10	4.35	0.03	.653
1.39	-8.65	24.83	2.97	4.18	0.04	.643
1.51	-8.23	22.81	2.83	4.03	0.04	.634
1.64	-8.00	21.11	2.70	3.91	0.04	.627
1.76	-7.42	19.81	2.62	3.78	0.04	.617
1.88	-6.77	18.69	2.56	3.65	0.05	.606
2.01	-6.23	17.77	2.51	3.54	0.05	.596
2.13	-5.66	16.94	2.47	3.43	0.05	.585
2.26	-5.38	15.92	2.39	3.33	0.06	.577
2.38	-5.05	14.99	2.32	3.23	0.06	.567
2.50	-4.80	14.13	2.25	3.14	0.06	.559
2.63	-4.57	13.40	2.19	3.06	0.07	.552
2.75	-4.43	12.58	2.11	2.98	0.07	.545
2.88	-4.17	11.95	2.06	2.90	0.07	.536
3.00	-3.95	11.28	2.00	2.82	0.08	.528
3.12	-3.67	10.74	1.96	2.74	0.08	.518
3.25	-3.44	10.25	1.92	2.67	0.09	.509
3.37	-3.14	9.79	1.89	2.59	0.09	.494
3.50	-2.73	9.49	1.89	2.51	0.10	.484
3.62	-2.51	9.16	1.87	2.45	0.10	.475
3.74	-2.20	8.85	1.86	2.38	0.11	.463
3.87	-1.92	8.63	1.86	2.32	0.11	.451
3.99	-1.60	8.37	1.86	2.25	0.12	.438
4.12	-1.34	8.15	1.86	2.19	0.12	.427
4.24	-1.16	7.92	1.85	2.14	0.12	.417
4.36	-0.90	7.70	1.85	2.08	0.13	.406
4.49	-0.66	7.55	1.86	2.03	0.13	.395
4.61	-0.54	7.36	1.85	1.99	0.14	.388
4.74	-0.38	7.14	1.84	1.94	0.14	.378
4.86	-0.30	6.99	1.83	1.91	0.14	.372
4.98	-0.15	6.77	1.82	1.86	0.15	.362
5.11	0.00	6.62	1.82	1.82	0.15	.354
5.23	0.07	6.49	1.81	1.79	0.15	.348
5.36	0.07	6.27	1.78	1.76	0.16	.342
5.48	0.03	6.02	1.74	1.73	0.17	.337
5.60	0.10	5.88	1.73	1.70	0.17	.331
5.73	0.17	5.74	1.72	1.67	0.17	.325
5.85	0.20	5.59	1.70	1.64	0.18	.319
5.98	0.20	5.38	1.67	1.61	0.19	.313
6.10	0.15	5.15	1.63	1.58	0.19	.307
6.22	0.22	5.02	1.62	1.55	0.20	.301
6.35	0.22	4.83	1.59	1.52	0.21	.295
6.47	0.15	4.65	1.55	1.50	0.21	.292
6.60	0.03	4.35	1.48	1.47	0.23	.284

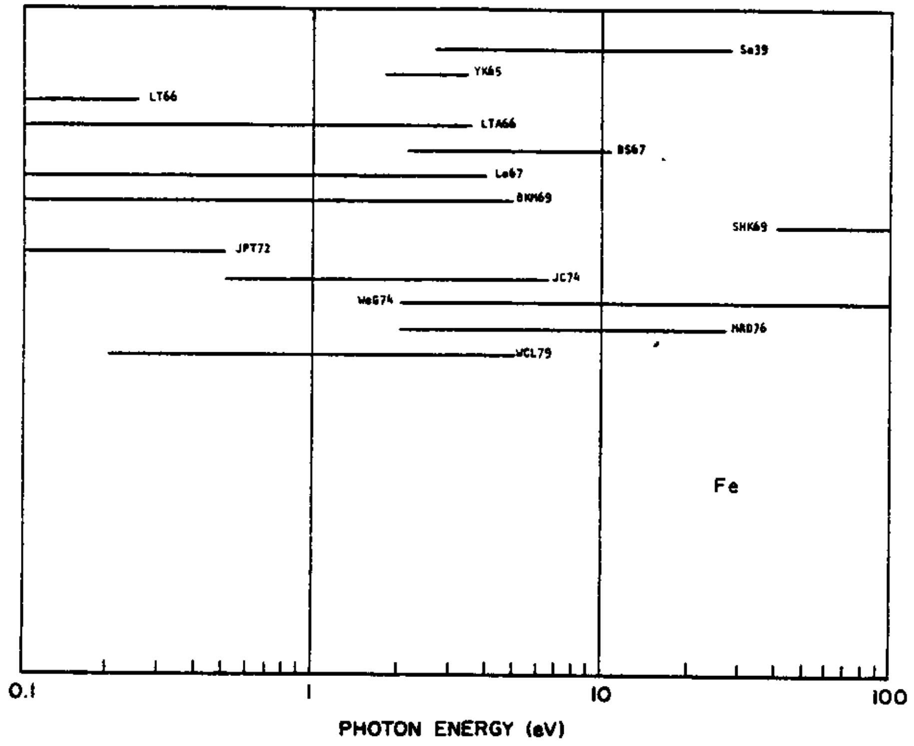

Fig. 22 Survey of available data for Fe

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Fe
				Film	X-tal	Bulk	Prep		
Sa39	2.6-27.6	Refl		x			Ex	R	
YK65	1.77-3.44	Ellips			x		In	n,k	crystal heated in H_2 to 800°C in uhv system
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,-\varepsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
BS67	~2.1-11.6	Refl				x	EP	R	
Le67	<4	Ellips				x	MP	ε_2/λ	data from LT66 and LTA66
BKM69	0.07-4.89	Ellips				x		n,k,σ	
SHK69	40-300	Trans		x			Ex	μ	optical absorption measurements, synchrotron radiation
ZR71			400-1100			x		ε_H	calorimetry; emissivity calculated
JPT72	~0.08-~0.48	Refl	9, 290			x		A	reflectivities relative to Au film
JC74	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	table of E,n,k
WeG74	2-130	Trans				x	Ex	KK: μ	energy loss spectroscopy
WGa74	2-120	Trans		x			Ex	μ, $\mathrm{im}(\varepsilon^{-1})$; KK: $\varepsilon_1,\varepsilon_2$	energy loss spectroscopy
MRD76	2-27	Refl		x		x	In	R; KK: $\varepsilon_1,\varepsilon_2$	synchrotron radiation, Ar-sputtered in situ
ST77	0.05-0.1	Ellips			x		MP	$-\varepsilon_1,\varepsilon_2$	
WCL79	0.2-5	Refl	4.2 for $h\nu$ < 4.4 eV			x	EP	A; KK: σ	absorptivity measured by calorimetry $h\nu$ < 4.4 eV, plotted data extended with reflectance data of MRD76

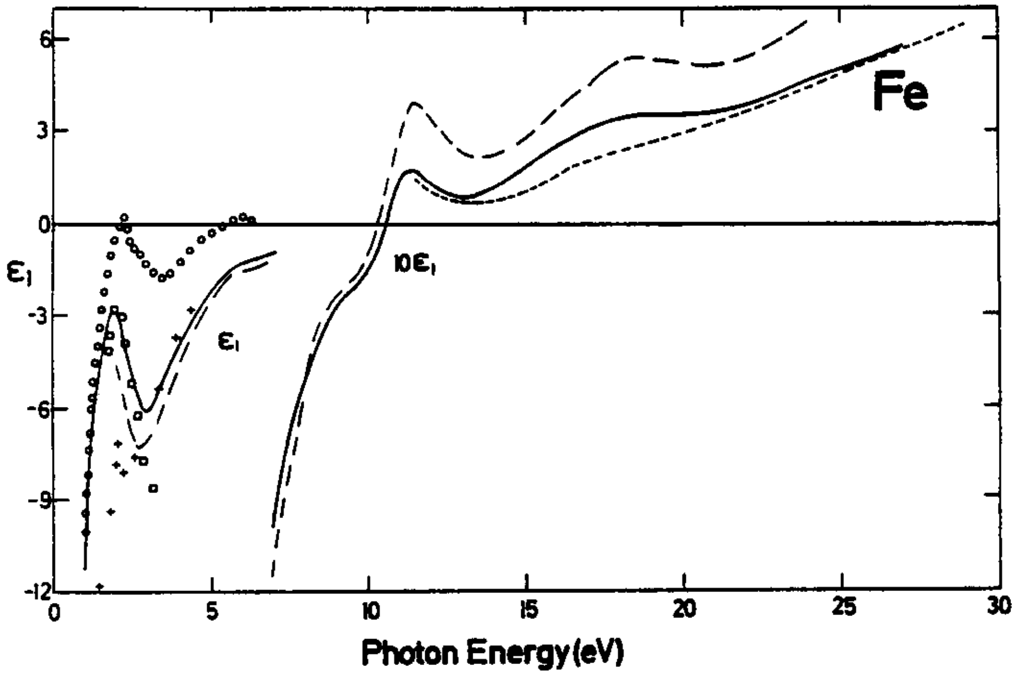

Fig. 24 ε_1 for Fe. —— WCL79; ooo JC74; □□□ YK65; — — — MRD76; --- WeG74; +++ BKM69.

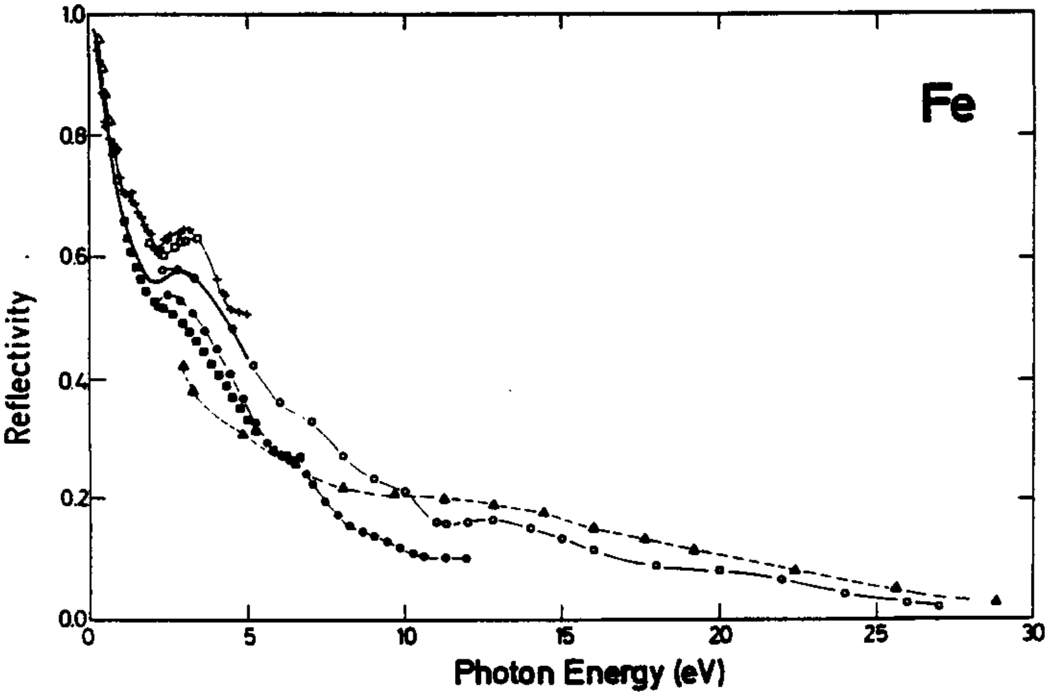

Fig. 23 Reflectivity of Fe. —— WCL79; □□□ YK65; •-•- BS67; ΔΔΔ JPT72; ■■■JC74; ▲-▲ WeG74; +++ BKM69; o-o-o MRD76.

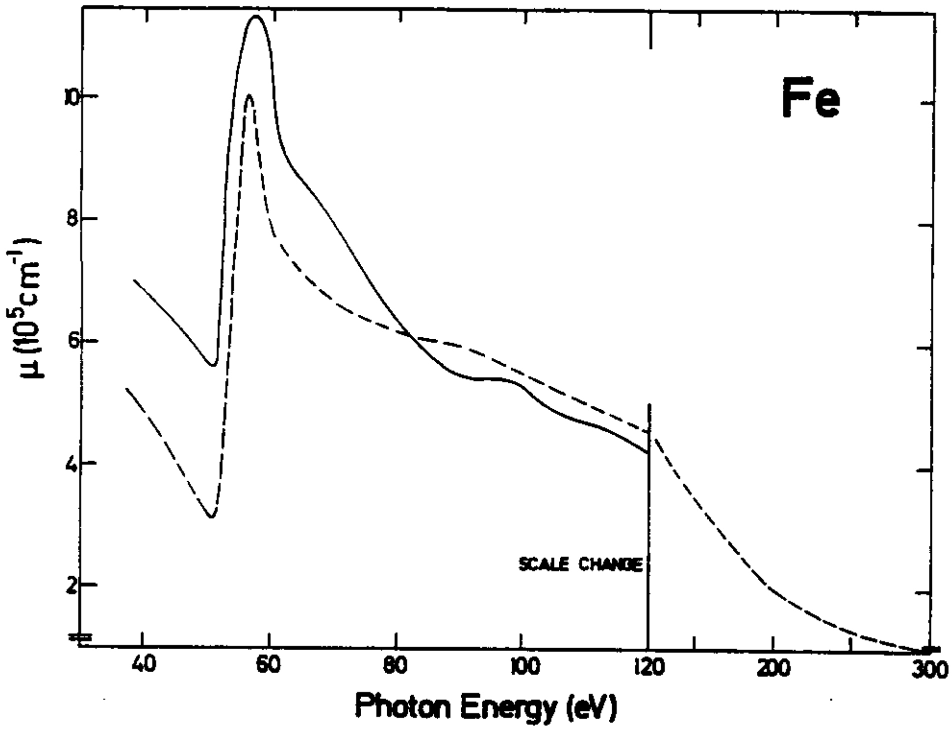

Fig. 26 Absorption coefficient for Fe. —— WeG74; --- SHK69.

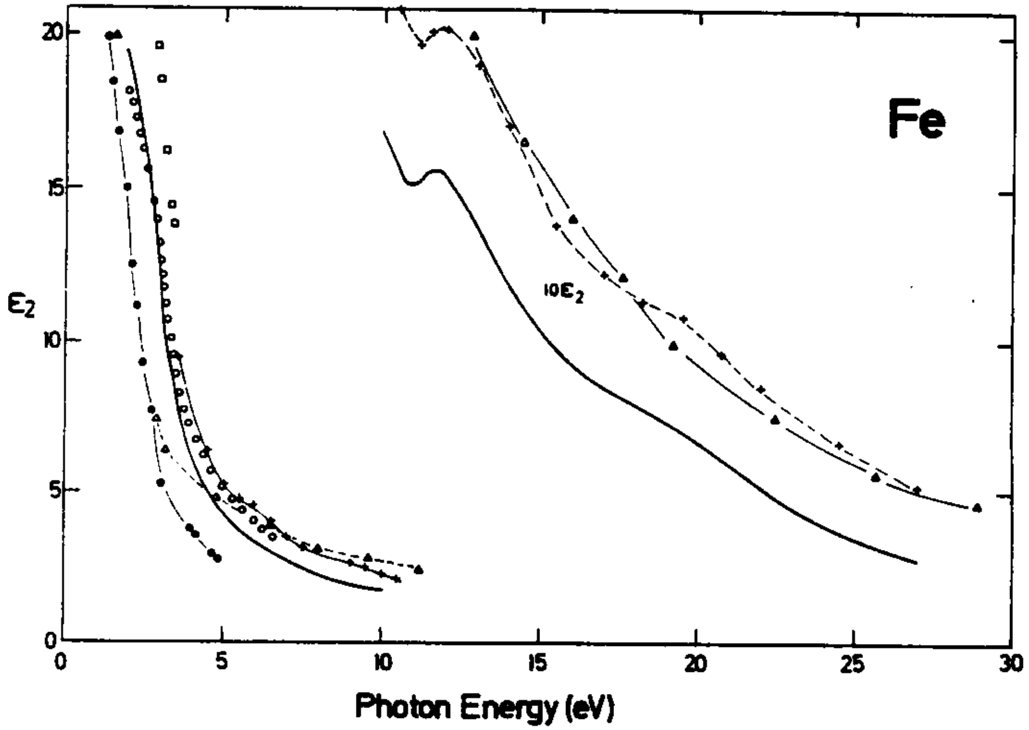

Fig. 25 ϵ_2 for Fe. —— WCL79; +++ MRD76; ●●● BKM69; □□□ YK65; ΔΔΔ WeG74; ooo JC74.

Iron

publication by J.H. Weaver, E. Colavita, D.W. Lynch, and R. Rosel in Phys. Rev. B 19, 3850 (1979) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-1052.76	424.38	6.41	33.07	0.00	.978
0.13	-679.13	335.64	6.26	26.80	0.00	.967
0.15	-481.49	285.48	6.26	22.82	0.00	.956
0.17	-391.70	257.79	6.28	20.52	0.00	.947
0.20	-318.60	134.32	3.68	18.23	0.00	.958
0.22	-215.90	148.27	4.80	15.46	0.00	.930
0.24	-187.84	144.72	4.96	14.58	0.00	.920
0.26	-162.22	136.16	4.98	13.68	0.00	.911
0.28	-143.23	123.34	4.78	12.89	0.00	.904
0.30	-121.57	117.37	4.87	12.05	0.00	.892
0.32	-110.64	109.19	4.73	11.53	0.00	.886
0.34	-96.94	102.55	4.70	10.91	0.01	.876
0.36	-87.07	97.83	4.68	10.44	0.01	.867
0.38	-80.04	93.33	4.63	10.07	0.01	.861
0.40	-75.50	66.24	4.42	9.75	0.01	.858
0.50	-47.17	66.32	4.14	8.02	0.01	.817
0.60	-32.79	54.65	3.93	6.95	0.01	.783
0.70	-23.73	46.63	3.78	6.17	0.02	.752
0.80	-18.07	40.84	3.65	5.60	0.02	.725
0.90	-14.18	36.32	3.52	5.16	0.02	.700
1.00	-11.20	32.84	3.43	4.79	0.03	.678
1.10	-9.33	30.07	3.33	4.52	0.03	.660
1.20	-7.66	27.67	3.24	4.26	0.03	.641
1.30	-6.51	25.72	3.16	4.07	0.04	.626
1.40	-5.23	24.16	3.12	3.87	0.04	.609
1.50	-4.93	22.95	3.05	3.77	0.04	.601
1.60	-3.91	21.60	3.00	3.60	0.04	.585
1.70	-3.47	20.97	2.98	3.52	0.05	.577
1.80	-3.44	20.24	2.92	3.46	0.05	.573
1.90	-2.96	19.50	2.89	3.37	0.05	.563
2.00	-3.12	19.20	2.85	3.36	0.05	.563
2.10	-3.26	18.69	2.80	3.34	0.05	.562
2.20	-3.61	18.23	2.74	3.33	0.05	.563
2.30	-4.12	17.65	2.65	3.34	0.05	.567
2.40	-4.43	16.93	2.56	3.31	0.06	.567
2.50	-4.87	16.29	2.46	3.31	0.06	.570
2.60	-5.45	15.44	2.34	3.30	0.06	.576
2.70	-5.58	14.51	2.23	3.25	0.06	.575
2.80	-5.95	13.66	2.12	3.23	0.06	.580
2.90	-6.04	12.72	2.01	3.17	0.06	.580
3.00	-6.21	11.76	1.88	3.12	0.07	.583
3.10	-6.04	10.82	1.78	3.04	0.07	.580
3.20	-5.67	10.02	1.70	2.95	0.07	.576
3.30	-5.65	9.28	1.62	2.87	0.08	.572
3.40	-5.35	8.63	1.55	2.79	0.08	.565
3.50	-5.01	8.11	1.50	2.70	0.09	.556
3.60	-4.74	7.70	1.47	2.63	0.09	.549
3.70	-4.53	7.33	1.43	2.56	0.10	.542
3.80	-4.25	6.95	1.39	2.49	0.10	.534

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
4.00	-4.01	6.22	1.30	2.39	0.11	.527
4.17	-3.59	5.71	1.26	2.27	0.13	.510
4.33	-3.24	5.34	1.23	2.18	0.14	.494
4.50	-2.98	5.02	1.20	2.10	0.15	.482
4.67	-2.74	4.68	1.16	2.02	0.16	.470
4.83	-2.43	4.42	1.14	1.93	0.17	.451
5.00	-2.18	4.24	1.14	1.87	0.19	.435
5.17	-2.04	4.05	1.12	1.81	0.20	.425
5.33	-1.82	3.90	1.11	1.75	0.21	.408
5.50	-1.72	3.74	1.09	1.71	0.22	.401
5.67	-1.52	3.61	1.09	1.65	0.24	.393
5.83	-1.40	3.53	1.10	1.61	0.24	.373
6.00	-1.32	3.47	1.09	1.59	0.25	.366
6.17	-1.31	3.38	1.08	1.57	0.26	.365
6.33	-1.31	3.23	1.04	1.55	0.27	.365
6.50	-1.24	3.07	1.02	1.51	0.28	.358
6.67	-1.16	2.93	1.00	1.47	0.29	.351
6.83	-1.11	2.79	0.97	1.43	0.31	.346
7.00	-1.00	2.66	0.96	1.39	0.33	.333
7.17	-0.94	2.54	0.94	1.35	0.35	.327
7.33	-0.81	2.44	0.94	1.30	0.37	.311
7.50	-0.71	2.38	0.94	1.26	0.39	.298
7.67	-0.63	2.33	0.94	1.23	0.40	.288
7.83	-0.57	2.28	0.94	1.21	0.41	.279
8.00	-0.52	2.23	0.94	1.18	0.43	.272
8.17	-0.47	2.18	0.94	1.16	0.44	.265
8.33	-0.42	2.14	0.94	1.14	0.45	.258
8.50	-0.37	2.10	0.94	1.12	0.46	.251
8.67	-0.34	2.06	0.94	1.10	0.47	.246
8.83	-0.31	2.02	0.93	1.08	0.48	.240
9.00	-0.28	1.99	0.93	1.07	0.49	.235
9.17	-0.27	1.95	0.92	1.06	0.50	.233
9.33	-0.25	1.90	0.91	1.04	0.52	.231
9.50	-0.23	1.85	0.90	1.02	0.53	.226
9.67	-0.20	1.80	0.90	1.00	0.55	.221
9.83	-0.19	1.75	0.89	0.99	0.56	.218
10.00	-0.17	1.69	0.88	0.97	0.59	.213
10.17	-0.11	1.63	0.87	0.94	0.61	.203
10.33	-0.07	1.60	0.87	0.91	0.62	.196
10.50	-0.03	1.56	0.87	0.89	0.64	.189
10.67	0.02	1.53	0.88	0.87	0.65	.179
10.83	0.08	1.51	0.89	0.85	0.66	.170
11.00	0.13	1.52	0.91	0.83	0.65	.162
11.17	0.16	1.54	0.92	0.83	0.64	.159
11.33	0.17	1.55	0.93	0.84	0.64	.159
11.50	0.16	1.56	0.93	0.84	0.63	.160
11.67	0.15	1.56	0.93	0.84	0.64	.162
11.83	0.14	1.55	0.92	0.84	0.64	.163
12.00	0.13	1.53	0.91	0.84	0.65	.163
12.17	0.11	1.51	0.90	0.84	0.66	.165
12.33	0.11	1.49	0.89	0.83	0.67	.164
12.50	0.09	1.47	0.88	0.83	0.68	.165
12.67	0.08	1.43	0.87	0.82	0.69	.166
12.83	0.07	1.39	0.86	0.81	0.71	.165
13.00	0.09	1.36	0.85	0.80	0.73	.162
13.17	0.09	1.33	0.84	0.79	0.75	.161
13.33	0.09	1.30	0.84	0.78	0.76	.160

Fe

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
13.50	0.09	1.27	0.83	0.77	0.78	.159
13.67	0.09	1.24	0.82	0.76	0.80	.157
13.83	0.10	1.21	0.81	0.75	0.82	.154
14.00	0.11	1.18	0.81	0.73	0.84	.151
14.17	0.12	1.16	0.80	0.72	0.85	.149
14.33	0.13	1.13	0.80	0.71	0.87	.146
14.50	0.14	1.11	0.79	0.70	0.89	.144
14.67	0.15	1.08	0.79	0.69	0.91	.141
14.83	0.16	1.05	0.78	0.67	0.93	.138
15.00	0.17	1.03	0.78	0.66	0.94	.135
15.17	0.19	1.01	0.78	0.65	0.96	.131
15.33	0.20	0.99	0.78	0.64	0.97	.128
15.50	0.20	0.98	0.77	0.63	0.98	.126
15.67	0.22	0.95	0.77	0.62	1.00	.123
15.83	0.23	0.94	0.77	0.61	1.01	.119
16.00	0.25	0.92	0.77	0.60	1.01	.116
16.17	0.26	0.91	0.78	0.58	1.02	.112
16.33	0.27	0.90	0.78	0.58	1.02	.110
16.50	0.28	0.88	0.78	0.57	1.03	.107
16.67	0.28	0.87	0.77	0.56	1.04	.106
16.83	0.30	0.86	0.78	0.55	1.04	.103
17.00	0.30	0.86	0.78	0.55	1.04	.102
17.17	0.31	0.84	0.78	0.54	1.05	.100
17.33	0.31	0.83	0.78	0.54	1.05	.099
17.50	0.32	0.82	0.77	0.53	1.06	.097
17.67	0.33	0.81	0.77	0.52	1.06	.095
17.83	0.34	0.80	0.78	0.51	1.06	.092
18.00	0.34	0.79	0.78	0.51	1.06	.091
18.17	0.35	0.79	0.78	0.51	1.05	.090
18.33	0.35	0.78	0.78	0.50	1.06	.089
18.50	0.35	0.77	0.77	0.50	1.07	.089
18.67	0.35	0.77	0.77	0.50	1.08	.088
18.83	0.35	0.76	0.77	0.49	1.09	.087
19.00	0.35	0.75	0.77	0.49	1.10	.087
19.17	0.34	0.74	0.76	0.49	1.11	.088
19.33	0.34	0.73	0.76	0.48	1.13	.087
19.50	0.34	0.71	0.75	0.47	1.14	.086
19.67	0.35	0.70	0.75	0.47	1.15	.085
19.83	0.35	0.69	0.75	0.46	1.16	.084
20.00	0.35	0.67	0.74	0.45	1.17	.083
20.17	0.35	0.66	0.74	0.44	1.17	.081
20.33	0.35	0.65	0.74	0.44	1.18	.081
20.50	0.35	0.64	0.74	0.43	1.20	.080
20.67	0.36	0.62	0.73	0.43	1.21	.079
20.83	0.36	0.61	0.73	0.42	1.21	.078
21.00	0.36	0.60	0.73	0.41	1.23	.077
21.17	0.36	0.58	0.72	0.40	1.24	.076
21.33	0.37	0.57	0.72	0.39	1.24	.074
21.50	0.37	0.56	0.72	0.38	1.24	.073
21.67	0.38	0.54	0.72	0.38	1.24	.071
21.83	0.38	0.53	0.72	0.37	1.25	.070
22.00	0.38	0.52	0.72	0.36	1.25	.068
22.17	0.39	0.50	0.71	0.35	1.25	.067
22.33	0.40	0.49	0.72	0.34	1.22	.064
22.50	0.40	0.48	0.72	0.34	1.22	.063
22.67	0.41	0.47	0.72	0.33	1.22	.062
22.83	0.41	0.46	0.72	0.32	1.20	.059

Fe

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
23.00	0.42	0.45	0.72	0.31	1.19	.058
23.17	0.43	0.43	0.72	0.30	1.17	.056
23.33	0.44	0.42	0.72	0.29	1.15	.054
23.50	0.45	0.41	0.73	0.28	1.11	.050
23.67	0.45	0.41	0.73	0.28	1.10	.049
23.83	0.47	0.40	0.74	0.27	1.06	.047
24.00	0.47	0.39	0.74	0.27	1.04	.045
24.17	0.48	0.39	0.74	0.26	1.02	.044
24.33	0.48	0.38	0.74	0.26	1.00	.043
24.50	0.49	0.37	0.74	0.25	0.99	.042
24.67	0.50	0.37	0.75	0.25	0.96	.040
24.83	0.50	0.36	0.75	0.24	0.95	.039
25.00	0.50	0.36	0.75	0.24	0.94	.038
26.00	0.54	0.31	0.76	0.21	0.81	.031
27.00	0.57	0.28	0.78	0.19	0.69	.026
28.00	0.61	0.25	0.79	0.16	0.59	.021
29.00	0.63	0.23	0.81	0.14	0.50	.017
30.00	0.66	0.21	0.82	0.13	0.43	.014

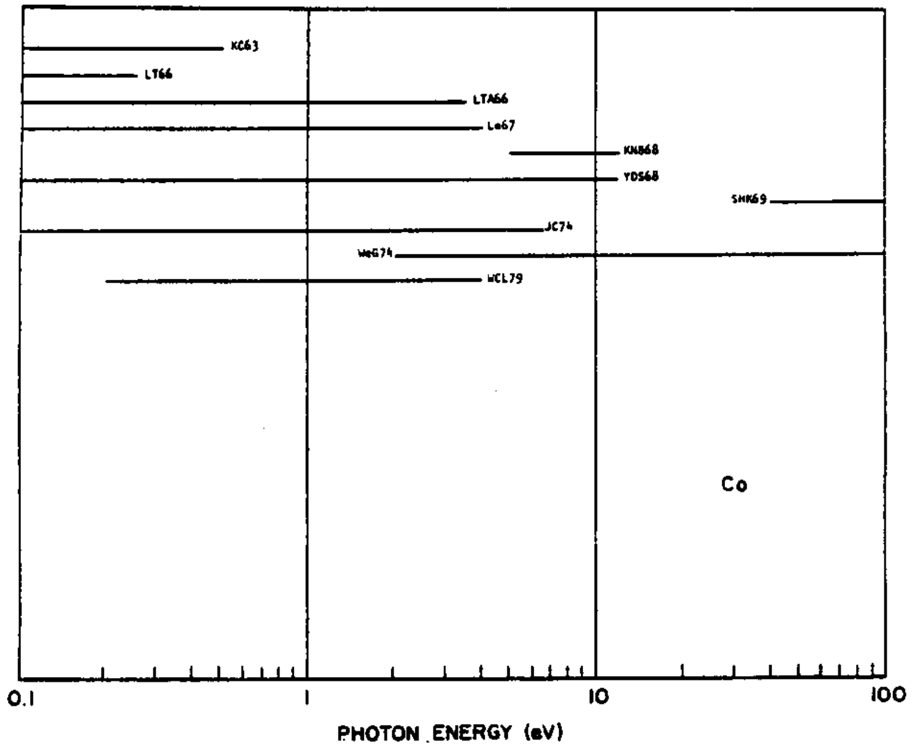

Fig. 27 Survey of available data for Co

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Co
KC63	0.06-0.5	Ellips				x	MP,EP	n,k	table λ,n,k
LT66	0.06-0.25	Ellips				x	MP	$\epsilon_2/\lambda, -\epsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\epsilon_2/\lambda, \epsilon_1$	
Le67	<4	Ellips				x	MP	ϵ_2/λ	data from LT66 and LTA66
KNB68	5-12	Ellips						R; KK: σ, $\mathrm{Im}(\epsilon^{-1})$, $\mathrm{Im}(\epsilon+1)^{-1}$	data from VAK67, KK analyzed
YDS68	0.05-11.8	Refl		x				R; KK: $\epsilon_1, \epsilon_2, \mu$, $\mathrm{Im}(\epsilon^{-1})$	
SHK69	40-300	Trans		x			Ex	μ	optical absorption, synchrotron radiation
JC74	0.5-6.5	Trans,Refl		x			Ex	n,k,σ	table of E,n,k
WeG74	2-130	Trans		x			Ex	KK: μ	energy loss spectroscopy
WGa74	2-120	Trans		x			Ex	μ, $\mathrm{Im}(\epsilon^{-1})$; KK: ϵ_1, ϵ_2	energy loss spectroscopy
ST77	0.05-0.1	Ellips			x		MP	$-\epsilon_1, \epsilon_2$	
WCL79	0.2-5	Refl	4.2 for $h\nu > 4.4$ eV		x		EP	A; KK: σ	absorptivity measured by calorimetry $h\nu < 4.4$ eV, single crystal $E \perp c$ and $E \parallel c$. Also thermoreflectance

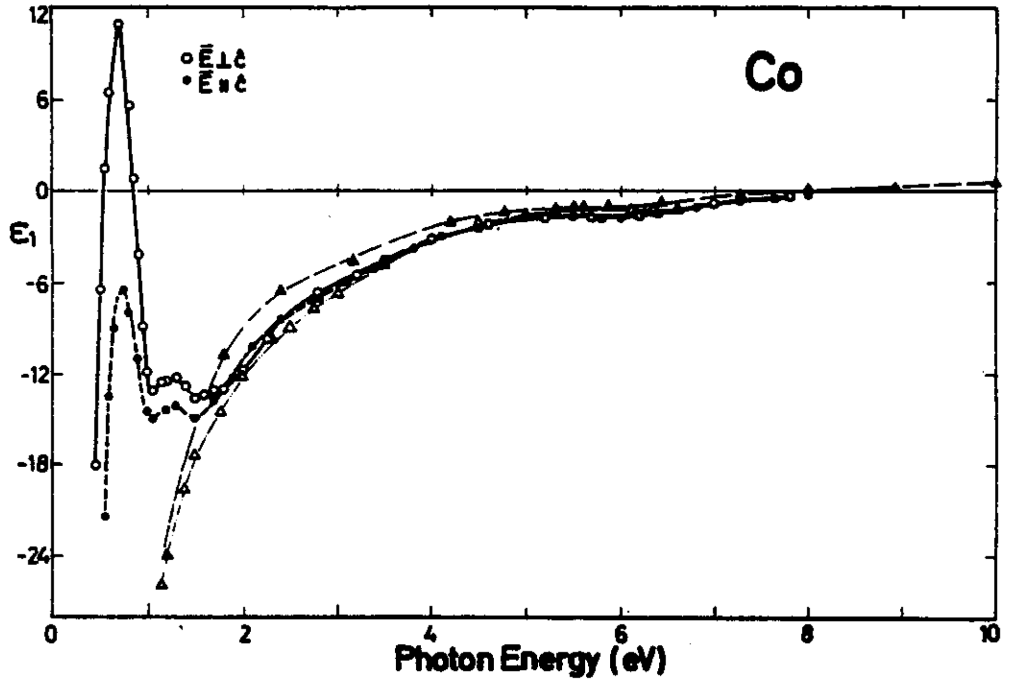

Fig. 29 ε_1 for Co. Only the results of WCL79 are for single crystal Co (●●● is $\vec{E}\parallel\hat{c}$; ooo is $\vec{E}\perp\hat{c}$); ΔΔΔ JC74; ▲▲▲ YDS68.

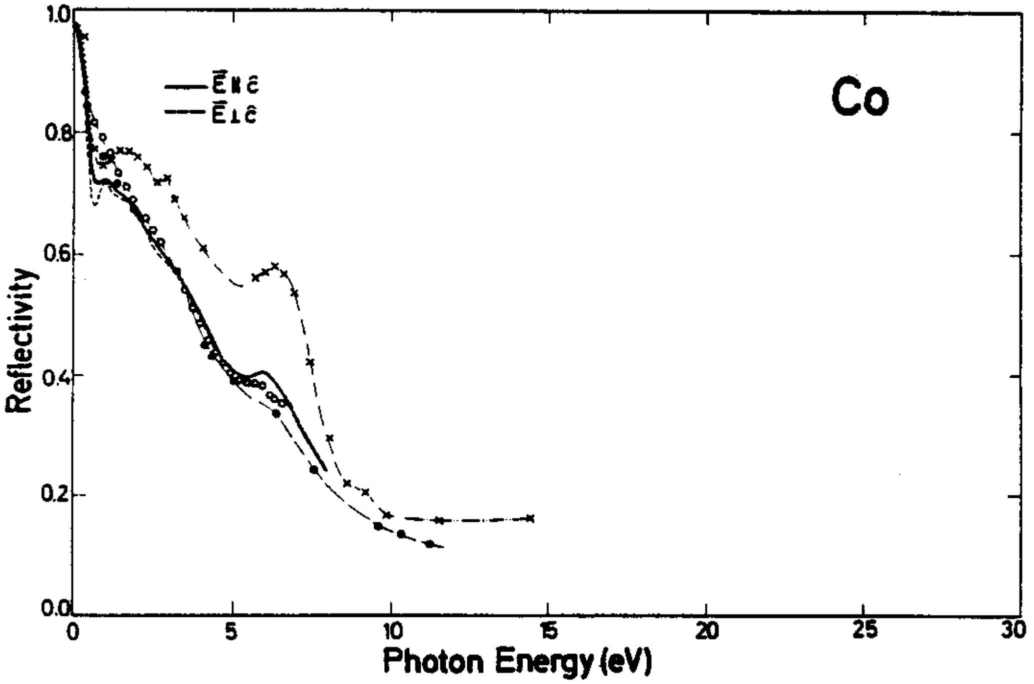

Fig. 28 Reflectivity for Co. Only the results of WCL79 are for single crystal Co (—— is $\vec{E}\parallel\hat{c}$; --- is $\vec{E}\perp\hat{c}$); ●●● YDS68; ooo JC74; xxx KNB68; ··· KC63.

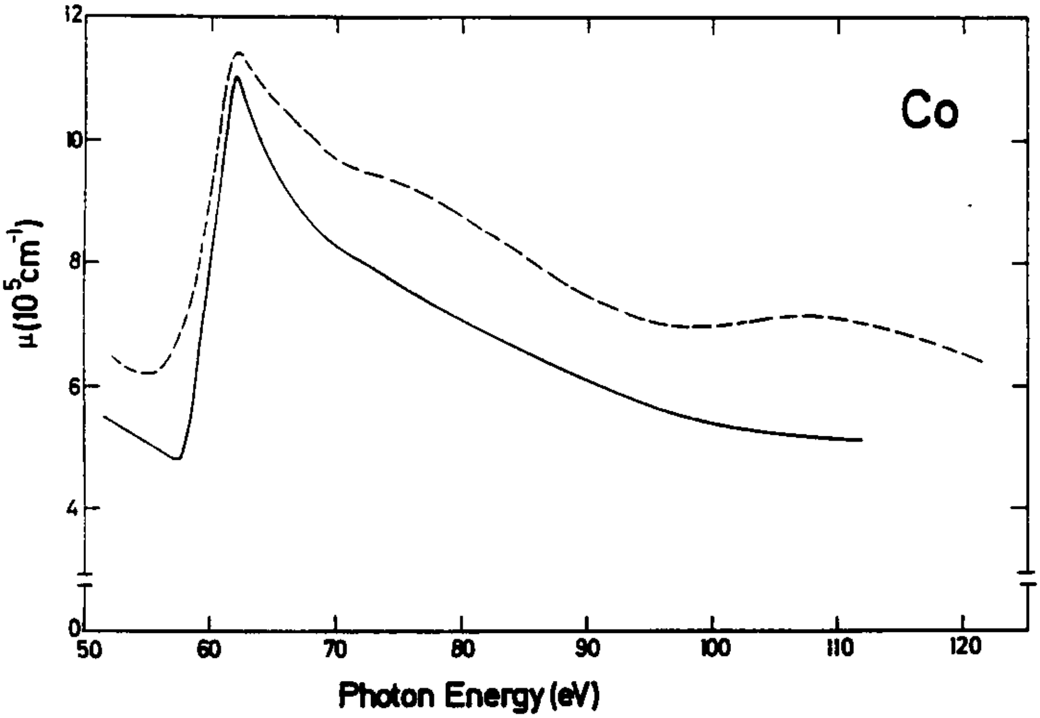

Fig. 31 Absorption coefficient for Co. —— SHK69; --- WeG74.

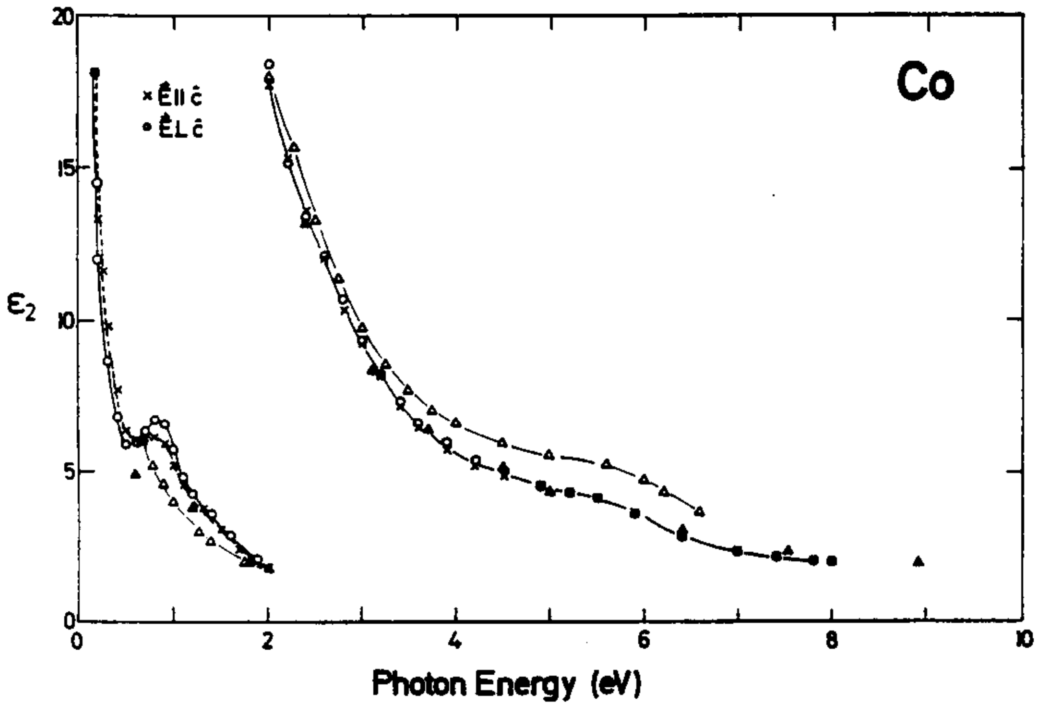

Fig. 30 ε_2 for Co. Only the results of WCL79 are for single crystal Co (xxx is $\vec{E} \parallel \hat{c}$; ooo is $\vec{E} \perp \hat{c}$); ΔΔΔ JC74; ▲▲▲YDS68.

Cobalt single crystal with $\vec{E} \parallel \hat{c}$

publication by J.H. Weaver, E. Colavita, D.W. Lynch, and R. Rosei in Phys. Rev. B 19, 3850 (1979) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
0.10	-1389.33	508.32	6.71	37.87	0.00	.982
0.13	-902.53	328.31	5.38	30.52	0.00	.978
0.15	-626.89	237.59	4.66	25.47	0.00	.973
0.17	-458.71	180.74	4.14	21.81	0.00	.967
0.20	-339.95	133.38	3.55	18.78	0.00	.962
0.25	-197.03	116.09	3.98	14.59	0.00	.933
0.30	-131.53	98.34	4.04	12.16	0.00	.907
0.35	-90.33	96.85	4.18	10.38	0.01	.876
0.40	-65.39	77.50	4.24	9.13	0.01	.847
0.45	-48.05	68.82	4.24	8.12	0.01	.819
0.50	-32.27	63.48	4.41	7.19	0.01	.782
0.55	-21.42	61.01	4.65	6.56	0.01	.752
0.60	-13.48	60.17	4.91	6.13	0.02	.729
0.65	-8.99	60.67	5.12	5.93	0.02	.718
0.70	-6.78	61.24	5.24	5.85	0.02	.713
0.75	-6.52	61.62	5.26	5.85	0.02	.713
0.80	-8.02	60.94	5.17	5.89	0.02	.716
0.85	-7.84	59.37	5.10	5.82	0.02	.713
0.90	-11.01	58.83	4.94	5.95	0.02	.720
0.95	-12.97	55.56	4.70	5.92	0.02	.722
1.00	-14.41	52.19	4.46	5.86	0.02	.722
1.05	-14.92	48.69	4.24	5.74	0.02	.719
1.10	-14.86	45.63	4.07	5.61	0.02	.715
1.15	-14.67	43.05	3.92	5.48	0.02	.711
1.20	-14.27	40.87	3.81	5.36	0.02	.706
1.25	-14.12	39.09	3.70	5.28	0.02	.703
1.30	-14.12	37.46	3.60	5.20	0.02	.701
1.35	-14.27	35.89	3.49	5.14	0.02	.701
1.40	-14.56	34.29	3.37	5.09	0.02	.701
1.45	-14.89	32.53	3.23	5.03	0.03	.701
1.50	-14.99	30.68	3.10	4.96	0.03	.701
1.55	-14.96	28.84	2.96	4.87	0.03	.700
1.60	-14.69	27.08	2.84	4.77	0.03	.697
1.65	-14.21	25.58	2.74	4.66	0.03	.693
1.70	-13.86	24.34	2.66	4.57	0.03	.690
1.75	-13.70	23.06	2.56	4.50	0.03	.689
1.80	-13.42	21.65	2.45	4.41	0.03	.687
1.85	-12.84	20.35	2.37	4.30	0.04	.682
1.90	-12.18	19.32	2.31	4.18	0.04	.675
1.95	-11.62	18.47	2.26	4.09	0.04	.669
2.00	-11.13	17.72	2.21	4.00	0.04	.664
2.10	-10.25	16.37	2.13	3.95	0.04	.654
2.20	-9.41	15.32	2.07	3.70	0.05	.642
2.30	-8.86	14.44	2.01	3.59	0.05	.634
2.40	-8.43	13.60	1.95	3.49	0.05	.627
2.50	-8.04	12.81	1.88	3.40	0.06	.622
2.60	-7.76	12.05	1.81	3.32	0.06	.613
2.70	-7.53	11.19	1.73	3.24	0.06	.615
2.80	-7.05	10.43	1.66	3.13	0.07	.607

Co $\vec{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
2.90	-6.68	9.81	1.61	3.05	0.07	.600
3.00	-6.36	9.22	1.55	2.96	0.07	.594
3.10	-6.01	8.67	1.51	2.88	0.08	.586
3.20	-5.70	8.17	1.46	2.80	0.08	.579
3.30	-5.39	7.70	1.42	2.72	0.09	.572
3.40	-5.07	7.26	1.38	2.64	0.09	.563
3.50	-4.76	6.86	1.34	2.56	0.10	.554
3.60	-4.44	6.49	1.31	2.48	0.10	.544
3.70	-4.10	6.20	1.29	2.40	0.11	.531
3.80	-3.81	5.95	1.28	2.33	0.12	.519
3.90	-3.54	5.73	1.26	2.27	0.13	.507
4.00	-3.28	5.54	1.26	2.20	0.13	.495
4.10	-3.05	5.38	1.25	2.15	0.14	.483
4.20	-2.83	5.24	1.25	2.10	0.15	.471
4.30	-2.66	5.13	1.25	2.05	0.15	.461
4.40	-2.51	5.01	1.24	2.01	0.16	.452
4.50	-2.36	4.90	1.24	1.98	0.17	.444
4.60	-2.22	4.82	1.24	1.94	0.17	.435
4.70	-2.13	4.74	1.24	1.91	0.18	.429
4.80	-2.04	4.65	1.23	1.88	0.18	.423
4.90	-1.95	4.56	1.23	1.86	0.19	.417
5.00	-1.87	4.49	1.22	1.83	0.19	.411
5.10	-1.81	4.42	1.22	1.81	0.19	.407
5.20	-1.76	4.35	1.21	1.79	0.20	.403
5.30	-1.72	4.29	1.21	1.78	0.20	.400
5.40	-1.71	4.23	1.19	1.77	0.20	.399
5.50	-1.71	4.15	1.18	1.76	0.21	.399
5.60	-1.72	4.07	1.16	1.75	0.21	.400
5.70	-1.76	3.96	1.13	1.75	0.21	.403
5.80	-1.79	3.81	1.10	1.73	0.21	.406
5.90	-1.79	3.64	1.07	1.71	0.22	.409
6.00	-1.76	3.47	1.03	1.68	0.23	.407
6.20	-1.66	3.15	0.97	1.62	0.25	.401
6.40	-1.47	2.88	0.94	1.53	0.28	.386
6.60	-1.29	2.66	0.91	1.46	0.30	.368
6.80	-1.08	2.51	0.91	1.38	0.34	.345
7.00	-0.92	2.39	0.91	1.32	0.36	.326
7.20	-0.76	2.30	0.91	1.26	0.39	.305
7.40	-0.62	2.22	0.92	1.21	0.42	.286
7.60	-0.50	2.16	0.93	1.17	0.44	.269
7.80	-0.39	2.11	0.94	1.13	0.46	.253
8.00	-0.29	2.07	0.95	1.09	0.47	.239

Cobalt single crystal with $\vec{E}\perp\hat{c}$

publication by J.H. Weaver, E. Colavita, D.W. Lynch, and R. Rosei in Phys. Rev. B 19, 3850 (1979) based on the following tabulation

Energy (eV)	ε_1	ε_2	n	k	Im$(-1/\tilde{\varepsilon})$	$R(\phi=0)$
0.10	-1013.25	377.34	5.83	32.36	0.00	.979
0.13	-646.91	247.56	4.78	25.88	0.00	.973
0.15	-438.85	181.23	4.24	21.37	0.00	.965
0.17	-310.66	145.32	4.02	18.08	0.00	.954
0.20	-226.40	120.11	3.87	15.53	0.00	.942
0.25	-129.44	101.60	4.19	12.12	0.00	.904
0.30	-81.36	86.82	4.34	10.01	0.01	.865
0.35	-51.09	76.89	4.54	8.47	0.01	.823
0.40	-32.83	68.69	4.66	7.39	0.01	.785
0.45	-18.06	62.77	4.86	6.46	0.01	.744
0.50	-6.37	59.48	5.17	5.75	0.02	.709
0.55	1.45	58.96	5.50	5.36	0.02	.690
0.60	6.51	59.70	5.77	5.17	0.02	.682
0.65	9.88	61.14	5.99	5.10	0.02	.680
0.70	10.86	63.94	6.15	5.20	0.02	.685
0.75	9.26	66.64	6.19	5.39	0.01	.693
0.80	5.58	68.20	6.08	5.61	0.01	.702
0.85	0.80	67.99	5.86	5.80	0.01	.709
0.90	-4.11	66.03	5.57	5.93	0.02	.715
0.95	-8.88	62.48	5.21	6.00	0.02	.720
1.00	-11.92	57.42	4.83	5.94	0.02	.721
1.05	-13.11	52.35	4.52	5.79	0.02	.717
1.10	-12.79	48.24	4.31	5.60	0.02	.711
1.15	-12.48	45.36	4.16	5.45	0.02	.705
1.20	-12.39	43.00	4.02	5.34	0.02	.701
1.25	-12.35	40.88	3.90	5.25	0.02	.697
1.30	-12.33	39.02	3.78	5.16	0.02	.694
1.35	-12.43	37.41	3.67	5.09	0.02	.692
1.40	-12.85	35.85	3.55	5.05	0.02	.692
1.45	-13.34	34.08	3.41	5.00	0.03	.693
1.50	-13.62	32.11	3.26	4.93	0.03	.692
1.55	-13.45	30.27	3.14	4.83	0.03	.689
1.60	-13.29	28.74	3.03	4.74	0.03	.687
1.65	-13.17	27.36	2.93	4.66	0.03	.685
1.70	-13.14	26.05	2.83	4.60	0.03	.684
1.75	-13.19	24.65	2.72	4.54	0.03	.684
1.80	-13.04	23.21	2.61	4.45	0.03	.683
1.85	-12.75	21.87	2.51	4.36	0.03	.680
1.90	-12.41	20.63	2.41	4.27	0.04	.677
1.95	-12.02	19.52	2.34	4.18	0.04	.673
2.00	-11.69	18.42	2.25	4.09	0.04	.670
2.10	-10.62	16.60	2.13	3.89	0.04	.659
2.20	-9.68	15.20	2.04	3.72	0.05	.646
2.30	-8.73	14.17	1.99	3.56	0.05	.632
2.40	-8.04	13.40	1.95	3.44	0.05	.620
2.50	-7.54	12.74	1.90	3.34	0.06	.611
2.60	-7.21	12.11	1.86	3.26	0.06	.605
2.70	-7.00	11.41	1.79	3.19	0.06	.602
2.80	-6.70	10.71	1.72	3.11	0.07	.596

Energy (eV)	ε_1	ε_2	n	k	Im$(-1/\tilde{\varepsilon})$	$R(\phi=0)$
2.90	-6.41	10.05	1.66	3.03	0.07	.591
3.00	-6.09	9.43	1.60	2.94	0.07	.585
3.10	-5.78	8.87	1.55	2.86	0.08	.578
3.20	-5.48	8.35	1.50	2.78	0.08	.571
3.30	-5.16	7.86	1.46	2.70	0.09	.562
3.40	-4.83	7.44	1.42	2.62	0.09	.553
3.50	-4.52	7.07	1.39	2.54	0.10	.543
3.60	-4.23	6.73	1.36	2.47	0.11	.533
3.70	-3.94	6.43	1.34	2.40	0.11	.522
3.80	-3.67	6.18	1.33	2.33	0.12	.511
3.90	-3.42	5.96	1.31	2.27	0.13	.500
4.00	-3.18	5.78	1.31	2.21	0.13	.488
4.10	-3.01	5.61	1.30	2.17	0.14	.480
4.20	-2.85	5.44	1.28	2.12	0.14	.471
4.30	-2.67	5.28	1.27	2.07	0.15	.461
4.40	-2.51	5.14	1.27	2.03	0.16	.452
4.50	-2.36	5.02	1.26	1.99	0.16	.444
4.60	-2.22	4.92	1.26	1.95	0.17	.435
4.70	-2.13	4.83	1.26	1.92	0.17	.429
4.80	-2.04	4.73	1.25	1.90	0.18	.423
4.90	-1.95	4.64	1.24	1.87	0.18	.417
5.00	-1.86	4.56	1.24	1.84	0.19	.411
5.10	-1.81	4.49	1.23	1.82	0.19	.407
5.20	-1.75	4.41	1.22	1.80	0.20	.403
5.30	-1.72	4.35	1.22	1.79	0.20	.400
5.40	-1.71	4.28	1.21	1.78	0.20	.399
5.50	-1.71	4.21	1.19	1.77	0.20	.399
5.60	-1.72	4.12	1.17	1.76	0.21	.400
5.70	-1.76	4.01	1.14	1.75	0.21	.403
5.80	-1.79	3.86	1.11	1.74	0.21	.406
5.90	-1.80	3.69	1.07	1.72	0.22	.407
6.00	-1.77	3.51	1.04	1.69	0.23	.407
6.20	-1.67	3.18	0.98	1.62	0.25	.401
6.40	-1.48	2.90	0.94	1.54	0.27	.386
6.60	-1.29	2.69	0.92	1.46	0.30	.368
6.80	-1.09	2.53	0.91	1.38	0.33	.345
7.00	-0.92	2.41	0.91	1.32	0.36	.326
7.20	-0.76	2.31	0.91	1.26	0.39	.305
7.40	-0.62	2.24	0.92	1.21	0.42	.286
7.60	-0.50	2.17	0.93	1.17	0.44	.269
7.80	-0.39	2.12	0.94	1.13	0.46	.253
8.00	-0.29	2.08	0.95	1.09	0.47	.239

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Ni
				Film	X-tal	Bulk	Prep		
BGK71	56-84	Trans		x			In	μ	optical absorption with synchrotron radiation
LRW71	0.08-4	Refl	4.2		x		EP	A; KK: σ	absorptivity measured by calorimetry, data extended to 20 eV using data of others $h\nu > 4$ eV
SN71	0.07-4.13	Ellips				x		n,k,ε_1,σ	table λ,n,k
St71	2-3	Ellips	77, 290, 500		x		Heat	σ/c	heated $\sim10^{-7}$, ~670 K in situ after MP
ZR71			400-1100			x		ε_H	technique: caliorimetry; emissivity calculated
JPT72	0.02-0.5	Refl	8, 300			x		A	
Ki72	0.06-4.9	Ellips			x		EP	n,k,σ,μ	table λ,n,k
GSS73	1.1-4.9	Ellips				x	MP	R,n,k,σ	heated ~725 K, $\sim10^{-6}$ Torr ex situ after MP
VP73	2-3	Refl	130, 295	x		x	EP, Sput	R	high precision reflectance with Al reference; electropolished, annealed, Ar sputtered and films
JC74	0.64-6.6	Trans, Refl		x			Ex	n,k,σ	Table E,n,k
WeG74	2-130	Trans		x			Ex	KK: μ	energy loss spectroscopy
WGa74	2-120	Trans		x			Ex	$\mu,\mathrm{Im}(\varepsilon^{-1})$; KK: $\varepsilon_1,\varepsilon_2$	energy loss spectroscopy
RG75			1300-1550	x				ε at $\lambda = 6500$ Å	
SN75	0.07-4.13	Ellips				x	Heat	σ	heated ~750 K ex situ after MP

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Ni
				Film	X-tal	Bulk	Prep		
Sa39	2.6-27.6	Refl		x			Ex	R	
Rob59	0.47-3.4	Ellips	88, 298, 473			x	EP	$n,k,\varepsilon_1,\varepsilon_2$	
EP063	0.1-11	Refl				x	EP	R; KK: $\varepsilon_1,\varepsilon_2$, $\mathrm{Im}(\varepsilon^{-1}),\sigma$	
DM65	0.1-1	Ellips				x		n,k	table λ,n,k
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
Le67	<4	Ellips				x	MP	ε_2/λ	data from LT66 and LTA66
LTA66	0.1-3.5						MP	$\varepsilon_2/\lambda,\varepsilon_1$	
NS66	~0.1-3	Ellips				x	Heat	σ	heated $\sim10^{-6}$, ~725 K after MP
GL68	2-5.6	m-θ				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
BG68	0.1-1.24	Refl	4.2			x		A	absorptivity measured by calorimetry
FSH69	0.2-10	Refl				x		R	
SHK69	40-300	Trans		x			Ex	μ	optical absorption with synchrotron radiation
SP69	0.46-5.86	Ellips	77-770			x	Heat	ε_2/λ	heated in situ ~770 K after EP
VA69	4-24	Refl		x			In	R; KK: $n,k,\varepsilon_1,\varepsilon_2$, $\mathrm{Im}(\varepsilon^{-1}),\mathrm{Im}(\varepsilon+1)^{-1}$	also photoemission
SS70	0.5-12	Refl				x	Heat	R	Ni and NiCu annealed in situ, also photoemission
St70	2-35	Ellips	77, 500			x	EP	σ/c	

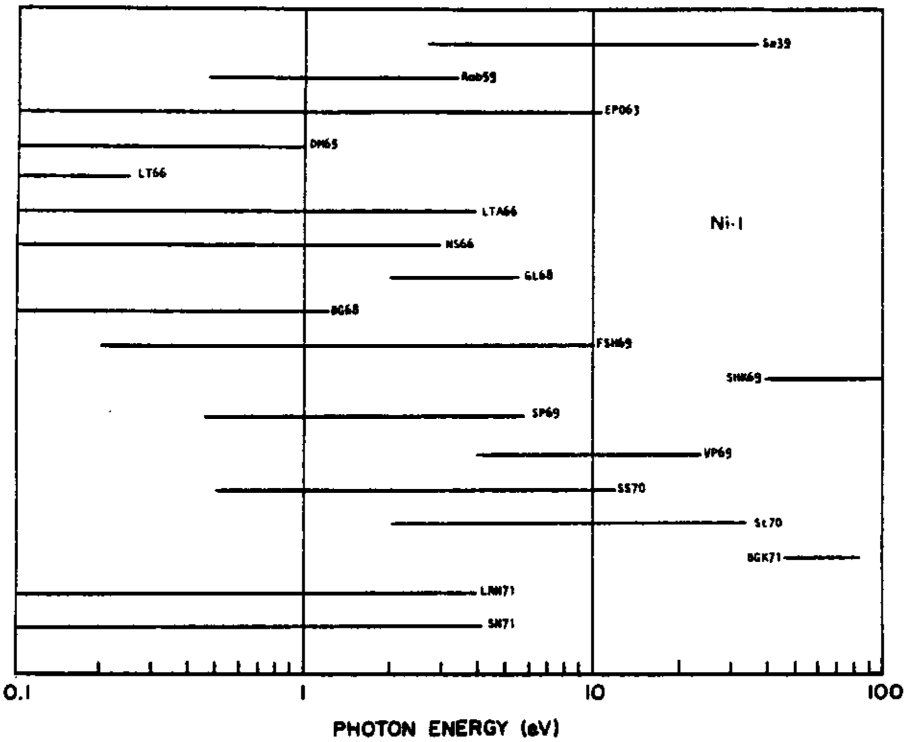

Fig. 32 Survey of available data for Ni

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Ni
				Film	X-tal	Bulk	Prep		
St75	1.8-3.5	Ellips	4.2, 300			x	EP	R, ε_1, ε_2	high precision $\tilde{\varepsilon}$
MKN76	~2.5-5.0	Refl		x				KK: ε_1	
MRD76	2-27	Refl		x		x	Sput	R; ε_1, ε_2	synchrotron radiation
Sm77	1.96, 2.27	Ellips				x	Sput	n, k	extensive surface studies, MP, annealed, sputtered, AES
ST77	0.05-0.1	Ellips	295		x		MP	ε_2/λ, ε_1	
TDB77	~0.4-6.5	Refl		x			Ex	KK: σ	differential beam studies of NiCu; films annealed ~675 K
GSB78	0.37-3.1	Ellips	RT, 1673, 1873			x	Melt	n, k, σ	plotted dtat is at RT; table λ, n, k
SJ78	2-3	Ellips			x		Heat	$\varepsilon_2(h\nu)^2$, ε_2/λ	heated ~10^{-7}, ~700 K in situ after MP
FSS79	0-150	Trans		x			Ex	KK: ε_1, ε_2, μ, R, Im(ε^{-1})	energy loss spectroscopy
SJ79	0.46-5.7	Ellips	160-685		x		Heat	ε_2/λ	heated in situ ~10^{-9}, ~700 K

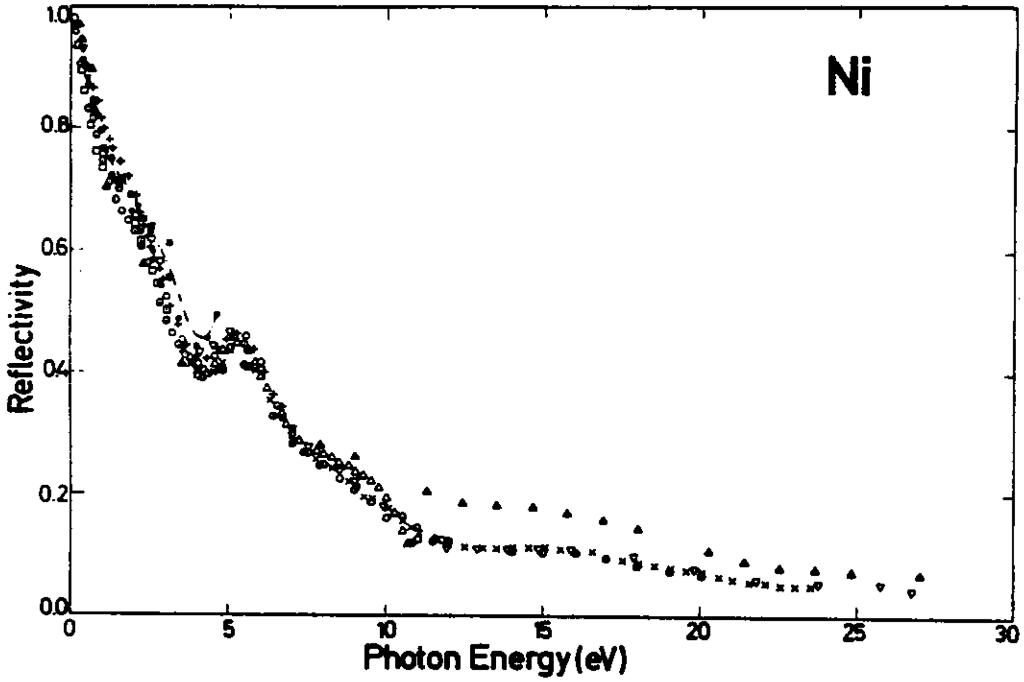

Fig. 33 Reflectivity of Ni. ◉◉◉ LRW71; +++ JC74; ---- KI72; ○○○ EP063; △△△ SS70; xxx VA69; ▽▽▽ MRD76; ▲▲▲ FSS79; ••• GSS73; □□□ DM65; ■■■ GSB78; ▼▼▼ SN71; ◇◇◇ JPT72; ⊞⊞⊞ VP73.

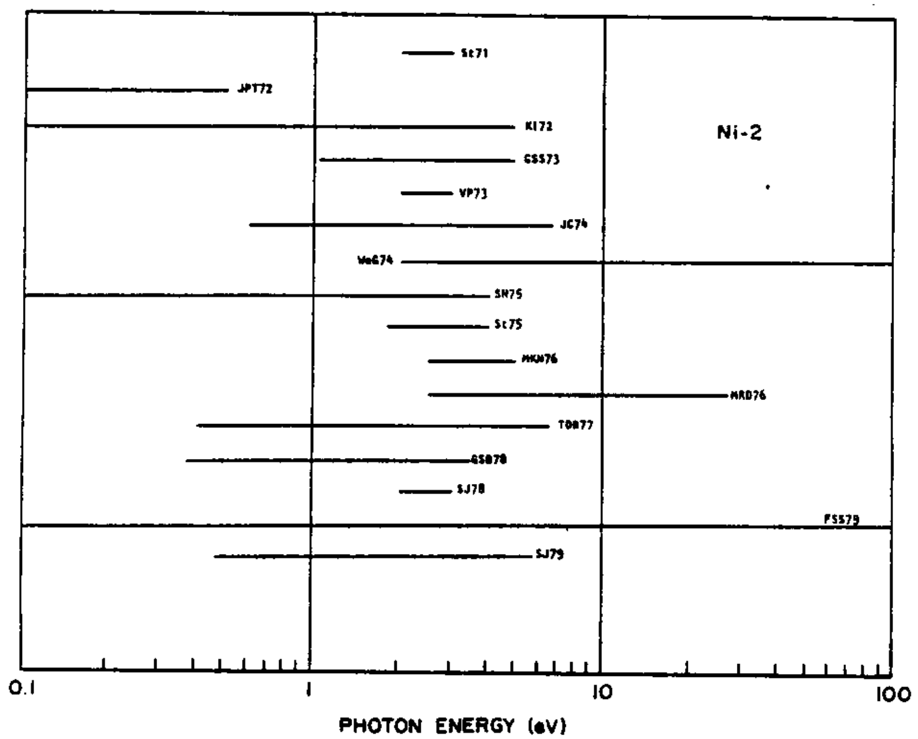

Fig. 32 Survey of available data for Ni

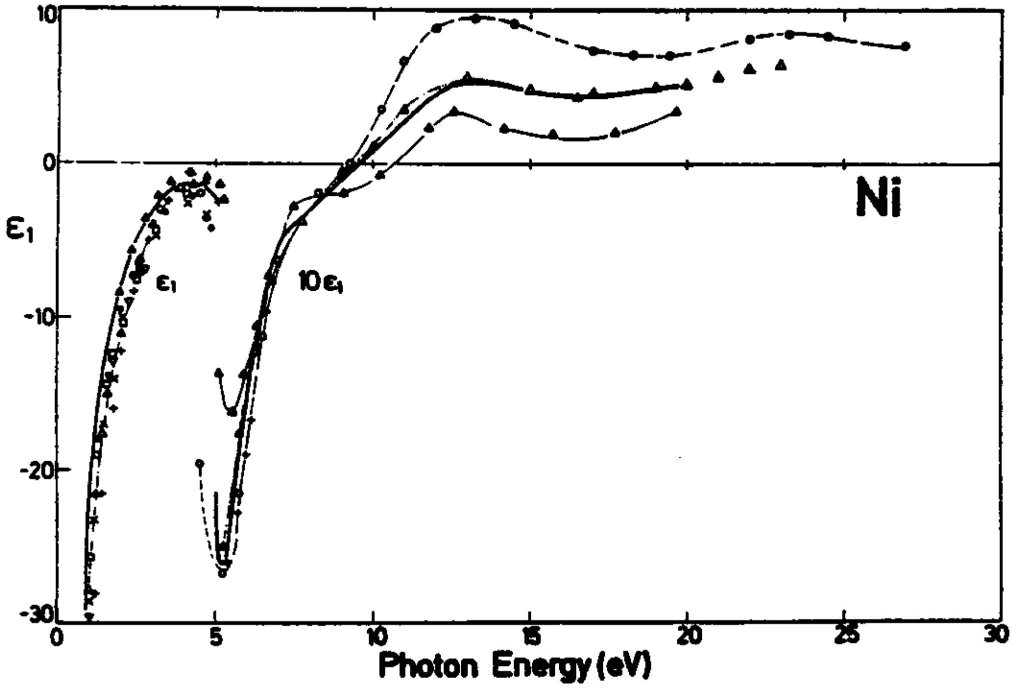

Fig. 35 ε_1 for Ni. —— LRW71; +++ JC74; xxx KI72; ΔΔΔ VA69; ooo MRD76; ▲▲▲ FSS79; ●●● GSS73; ∇∇∇ GSB78; □□□ SN71.

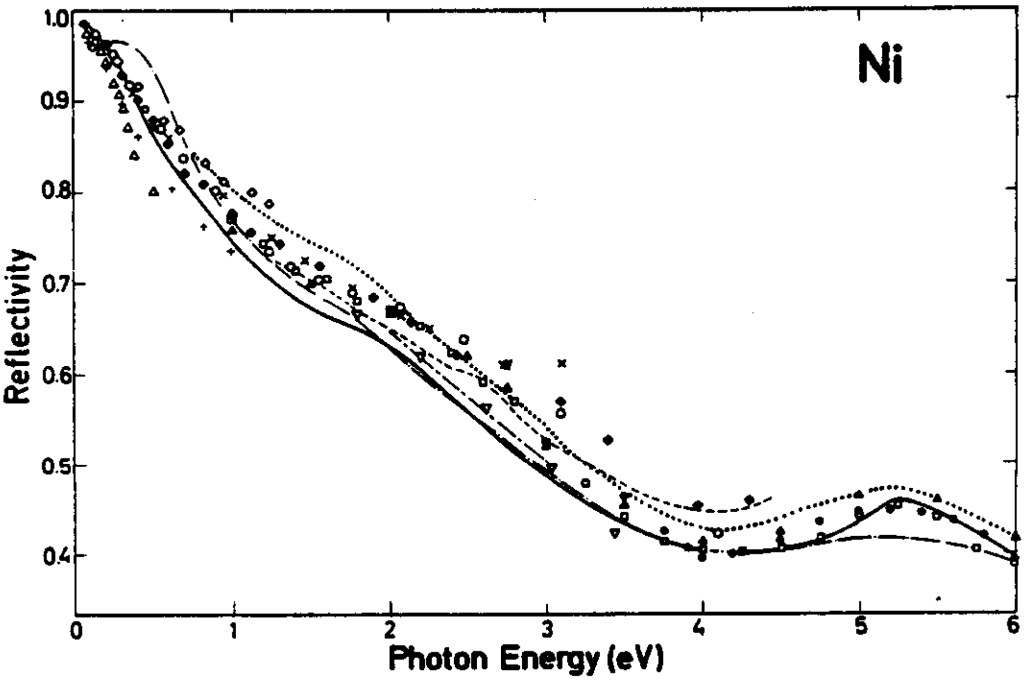

Fig. 34 Reflectivity of Ni for $0 \le h\nu \le 6$ eV. —— LRW71; -·-·- FSS79; ΔΔΔ JPT72; □□□ VA69; ◆◆◆ KI72; +++ DM65; - — - VP73; xxx GSB78; --- GSS73; ··· JC74; ooo SN71; ●●● SS70; ▲▲▲ EPO63; ∇∇∇ St75; ◇◇◇ BG68.

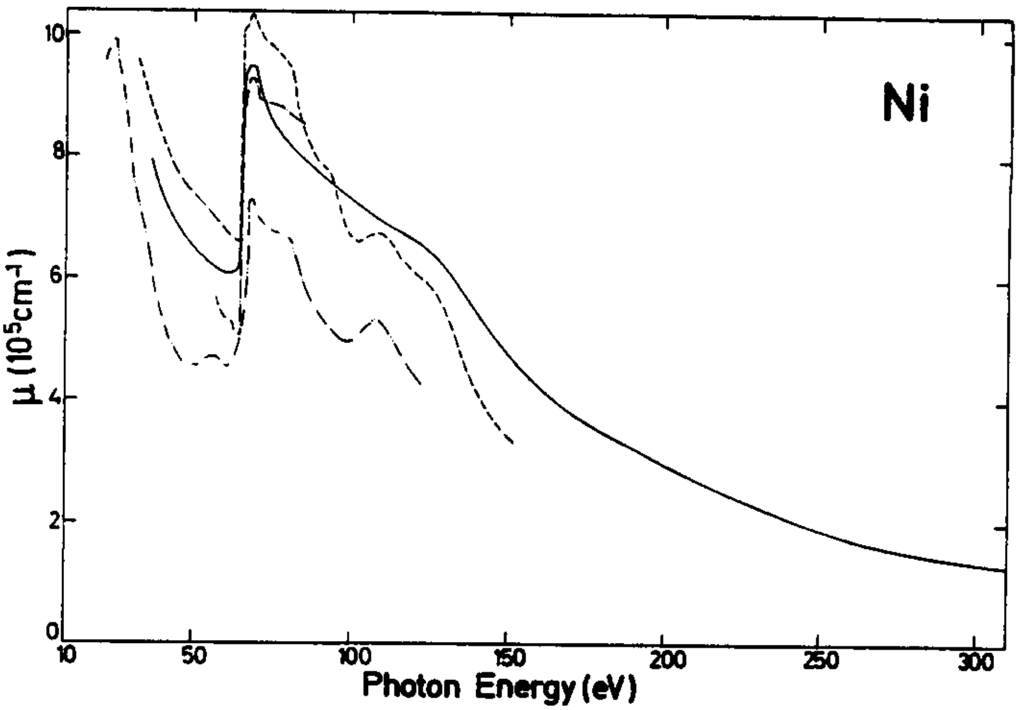

Fig. 37 Absorption coefficient for Ni. —— SHK69; --- BGK71; --- FSS79; — ·· — WeG74.

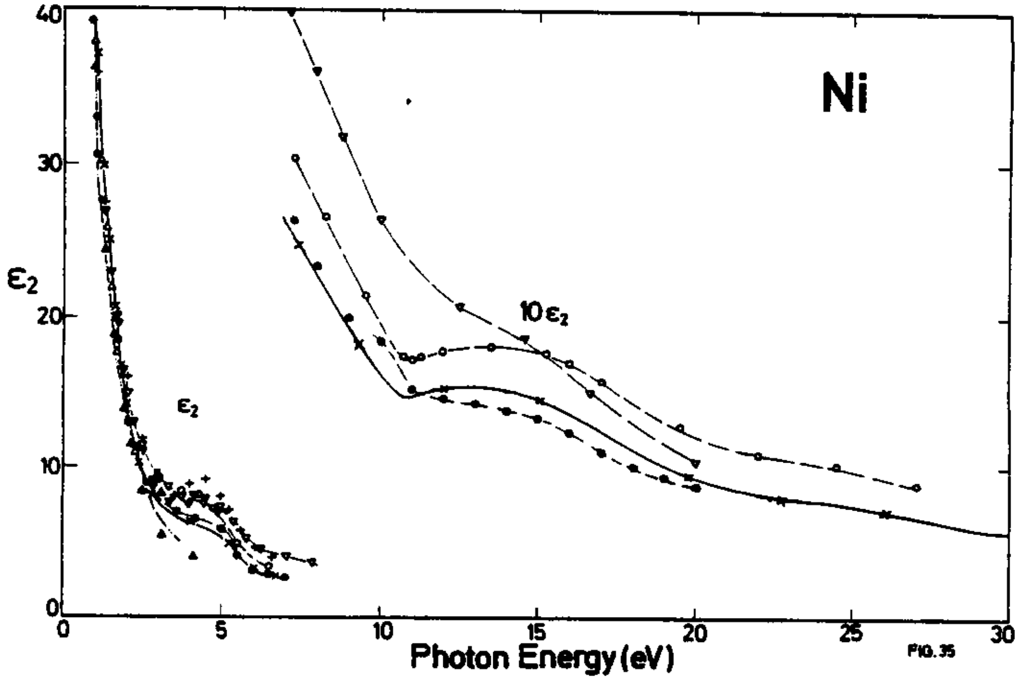

Fig. 36 ϵ_2 for Ni. ●●● LRW71; +++ JC74; — ·· — KI72; xxx VA69; ooo MRD76; ▽▽▽ FSS79; ▼▼▼ GSS73; ΔΔΔ GSB78; ▲▲▲SN71.

Nickel

publication by D.W. Lynch, R. Rosei, and J.H. Weaver in Solid State Commun. 9, 2195 (1971) using VUV reflectance from literature based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-2008.21	873.91	9.54	45.82	0.00	.983
0.11	-1679.25	678.58	8.12	41.78	0.00	.982
0.12	-1414.43	544.30	7.11	38.28	0.00	.981
0.13	-1204.89	454.96	6.44	35.31	0.00	.980
0.14	-1040.11	382.26	5.83	32.77	0.00	.979
0.15	-903.95	332.75	5.45	30.56	0.00	.978
0.16	-794.89	286.10	5.00	28.63	0.00	.977
0.17	-698.48	251.24	4.68	26.84	0.00	.975
0.18	-616.88	224.46	4.45	25.23	0.00	.973
0.19	-547.89	204.67	4.30	23.80	0.00	.971
0.20	-488.59	185.08	4.12	22.48	0.00	.969
0.21	-434.83	175.40	4.13	21.26	0.00	.965
0.22	-391.90	165.99	4.11	20.22	0.00	.962
0.23	-354.15	159.46	4.14	19.27	0.00	.958
0.24	-322.31	153.52	4.16	18.43	0.00	.955
0.25	-294.62	150.21	4.25	17.68	0.00	.950
0.26	-272.59	146.36	4.29	17.06	0.00	.946
0.27	-253.62	142.05	4.30	16.50	0.00	.943
0.28	-237.13	137.40	4.30	15.99	0.00	.939
0.29	-222.59	132.03	4.26	15.51	0.00	.937
0.30	-208.87	126.17	4.19	15.05	0.00	.934
0.31	-195.53	121.47	4.16	14.59	0.00	.930
0.32	-183.84	116.70	4.12	14.17	0.00	.927
0.33	-172.61	112.83	4.10	13.76	0.00	.924
0.34	-162.93	109.11	4.07	13.40	0.00	.921
0.35	-154.06	105.17	4.03	13.05	0.00	.918
0.36	-145.49	101.57	4.00	12.71	0.00	.914
0.37	-137.66	98.24	3.97	12.39	0.00	.911
0.38	-130.47	94.54	3.91	12.07	0.00	.908
0.39	-123.03	91.24	3.88	11.75	0.00	.904
0.40	-115.85	87.79	3.84	11.43	0.00	.900
0.45	-86.18	85.49	4.20	10.19	0.01	.872
0.50	-76.62	77.71	4.03	9.64	0.01	.864
0.55	-64.35	69.57	3.90	8.92	0.01	.849
0.60	-54.99	64.04	3.84	8.35	0.01	.835
0.65	-49.03	58.49	3.69	7.92	0.01	.826
0.70	-43.03	53.76	3.59	7.48	0.01	.813
0.75	-38.64	49.80	3.49	7.13	0.01	.803
0.80	-35.06	46.03	3.38	6.82	0.01	.794
0.85	-31.77	42.56	3.27	6.51	0.02	.785
0.90	-28.69	39.64	3.18	6.23	0.02	.774
0.95	-26.10	37.13	3.11	5.98	0.02	.764
1.00	-23.64	35.09	3.06	5.74	0.02	.753
1.05	-21.73	33.42	3.01	5.55	0.02	.743
1.10	-20.16	31.96	2.97	5.38	0.02	.734
1.15	-19.02	30.50	2.91	5.24	0.02	.723
1.20	-17.69	29.05	2.85	5.10	0.02	.721
1.25	-16.84	27.77	2.80	4.97	0.03	.714
1.30	-16.00	26.57	2.74	4.85	0.03	.705

Ni

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
1.35	-15.15	25.47	2.69	4.73	0.03	.701
1.40	-14.42	24.55	2.65	4.63	0.03	.695
1.45	-13.99	23.62	2.59	4.55	0.03	.692
1.50	-13.52	22.63	2.53	4.47	0.03	.688
1.55	-13.02	21.72	2.48	4.38	0.03	.683
1.60	-12.65	20.92	2.43	4.31	0.04	.679
1.65	-12.45	20.07	2.36	4.25	0.04	.678
1.70	-12.27	19.06	2.28	4.18	0.04	.677
1.75	-11.87	18.05	2.21	4.09	0.04	.673
1.80	-11.48	17.11	2.14	4.01	0.04	.670
1.85	-10.99	16.24	2.08	3.91	0.04	.665
1.90	-10.51	15.47	2.02	3.82	0.04	.659
1.95	-10.06	14.77	1.98	3.74	0.05	.654
2.00	-9.65	14.07	1.92	3.65	0.05	.649
2.10	-8.67	12.91	1.85	3.48	0.05	.634
2.20	-7.85	11.96	1.80	3.33	0.06	.620
2.30	-7.10	11.15	1.75	3.19	0.06	.605
2.40	-6.41	10.44	1.71	3.06	0.07	.590
2.50	-5.80	9.80	1.67	2.93	0.08	.575
2.60	-5.15	9.30	1.65	2.81	0.08	.557
2.70	-4.65	8.87	1.64	2.71	0.09	.542
2.80	-4.17	8.48	1.63	2.61	0.10	.525
2.90	-3.72	8.16	1.62	2.52	0.10	.509
3.00	-3.36	7.87	1.61	2.44	0.11	.495
3.10	-2.98	7.61	1.61	2.36	0.11	.480
3.20	-2.67	7.40	1.61	2.30	0.12	.467
3.30	-2.39	7.20	1.61	2.23	0.13	.454
3.40	-2.11	7.01	1.62	2.17	0.13	.441
3.50	-1.82	6.87	1.63	2.11	0.14	.428
3.60	-1.57	6.78	1.64	2.07	0.14	.416
3.70	-1.32	6.73	1.66	2.02	0.14	.405
3.80	-1.12	6.74	1.69	1.99	0.14	.397
3.90	-0.99	6.80	1.72	1.98	0.14	.393
4.00	-0.93	6.88	1.73	1.98	0.14	.392
4.10	-0.95	6.95	1.74	2.00	0.14	.394
4.20	-0.99	6.99	1.74	2.01	0.14	.396
4.30	-1.12	7.04	1.73	2.03	0.14	.402
4.40	-1.31	7.02	1.71	2.06	0.14	.409
4.50	-1.49	6.94	1.67	2.07	0.14	.415
4.60	-1.69	6.82	1.63	2.09	0.14	.421
4.70	-1.90	6.66	1.59	2.10	0.14	.428
4.80	-2.09	6.45	1.53	2.11	0.14	.435
4.90	-2.30	6.19	1.47	2.11	0.14	.443
5.00	-2.44	5.85	1.40	2.10	0.15	.449
5.10	-2.50	5.50	1.33	2.07	0.15	.451
5.20	-2.54	5.16	1.27	2.04	0.16	.454
5.30	-2.51	4.80	1.21	1.99	0.16	.454
5.40	-2.41	4.49	1.16	1.94	0.17	.449
5.50	-2.29	4.22	1.12	1.89	0.19	.443
5.60	-2.16	3.99	1.09	1.83	0.19	.435
5.70	-2.04	3.78	1.06	1.78	0.20	.426
5.80	-1.90	3.59	1.04	1.73	0.22	.417
5.90	-1.75	3.43	1.02	1.67	0.23	.405
6.20	-1.36	3.09	1.00	1.54	0.27	.371
6.40	-1.11	2.94	1.01	1.46	0.30	.345
6.60	-0.93	2.84	1.01	1.40	0.32	.325
6.80	-0.78	2.74	1.02	1.35	0.34	.308

NI

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
7.00	-0.63	2.68	1.03	1.30	0.35	.291
7.20	-0.56	2.63	1.03	1.27	0.36	.282
7.40	-0.49	2.56	1.03	1.24	0.38	.273
7.60	-0.43	2.46	1.02	1.22	0.39	.265
7.80	-0.37	2.40	1.01	1.18	0.41	.256
8.00	-0.31	2.33	1.01	1.15	0.42	.248
8.20	-0.27	2.27	1.00	1.13	0.43	.242
8.40	-0.24	2.19	0.99	1.11	0.45	.235
8.60	-0.19	2.11	0.98	1.08	0.47	.228
8.80	-0.15	2.03	0.97	1.05	0.49	.220
9.00	-0.10	1.96	0.97	1.01	0.51	.211
9.20	-0.05	1.89	0.96	0.99	0.53	.203
9.40	0.00	1.83	0.95	0.96	0.55	.194
9.60	0.04	1.76	0.95	0.93	0.57	.185
9.80	0.10	1.70	0.95	0.89	0.59	.175
10.00	0.14	1.64	0.95	0.87	0.61	.166
10.20	0.20	1.58	0.95	0.83	0.62	.155
10.40	0.26	1.52	0.95	0.80	0.64	.145
10.60	0.37	1.48	0.97	0.76	0.64	.129
10.80	0.43	1.48	0.99	0.75	0.62	.123
11.00	0.50	1.47	1.01	0.73	0.61	.115
11.25	0.56	1.49	1.04	0.72	0.59	.111
11.50	0.60	1.51	1.05	0.71	0.57	.109
11.75	0.62	1.52	1.07	0.71	0.56	.108
12.00	0.63	1.53	1.07	0.71	0.56	.108
12.25	0.64	1.53	1.07	0.71	0.56	.107
12.50	0.65	1.53	1.08	0.71	0.55	.106
12.75	0.65	1.53	1.08	0.71	0.55	.106
13.00	0.66	1.52	1.08	0.71	0.55	.105
13.25	0.66	1.52	1.08	0.71	0.55	.105
13.50	0.65	1.51	1.07	0.70	0.56	.105
13.75	0.65	1.51	1.07	0.70	0.56	.105
14.00	0.63	1.50	1.07	0.71	0.56	.106
14.25	0.62	1.49	1.06	0.70	0.57	.106
14.50	0.61	1.48	1.05	0.70	0.58	.106
14.75	0.59	1.47	1.04	0.70	0.59	.107
15.00	0.57	1.44	1.03	0.70	0.60	.107
15.25	0.56	1.41	1.02	0.69	0.61	.106
15.50	0.55	1.39	1.01	0.69	0.62	.105
15.75	0.54	1.36	1.00	0.68	0.63	.104
16.00	0.53	1.34	0.99	0.67	0.65	.103
16.50	0.51	1.29	0.98	0.66	0.67	.101
17.00	0.51	1.23	0.96	0.64	0.69	.098
17.50	0.49	1.18	0.94	0.63	0.72	.096
18.00	0.49	1.12	0.92	0.61	0.75	.092
18.50	0.49	1.06	0.91	0.58	0.77	.087
19.00	0.50	1.01	0.90	0.56	0.79	.082
19.50	0.51	0.96	0.90	0.54	0.81	.077
20.00	0.54	0.92	0.89	0.51	0.81	.071
20.50	0.55	0.88	0.89	0.49	0.81	.066
21.00	0.58	0.85	0.90	0.47	0.80	.061
21.50	0.61	0.83	0.91	0.46	0.78	.057
22.00	0.62	0.82	0.91	0.45	0.77	.055
22.50	0.63	0.81	0.91	0.44	0.77	.053
23.00	0.65	0.80	0.92	0.44	0.76	.051
23.50	0.64	0.80	0.91	0.44	0.77	.052
24.00	0.63	0.78	0.90	0.43	0.77	.051

NI

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
24.50	0.62	0.77	0.90	0.43	0.79	.051
25.00	0.61	0.74	0.89	0.42	0.80	.050
26.00	0.62	0.69	0.88	0.39	0.81	.046
27.00	0.62	0.65	0.87	0.37	0.80	.042
28.00	0.63	0.62	0.87	0.35	0.80	.040
29.00	0.63	0.58	0.86	0.34	0.79	.037
30.00	0.64	0.55	0.86	0.32	0.77	.034
35.00	0.68	0.41	0.86	0.24	0.66	.022
40.00	0.71	0.31	0.87	0.18	0.51	.014
45.00	0.76	0.23	0.88	0.13	0.36	.008
50.00	0.83	0.18	0.92	0.10	0.25	.004
60.00	0.91	0.16	0.96	0.08	0.18	.002
65.00	0.95	0.17	0.98	0.09	0.18	.002
68.00	0.91	0.24	0.96	0.12	0.27	.004
70.00	0.88	0.20	0.94	0.11	0.25	.004
75.00	0.88	0.16	0.94	0.09	0.20	.003
80.00	0.88	0.14	0.94	0.07	0.17	.002
90.00	0.89	0.11	0.94	0.06	0.13	.002

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Zr
BDL77	0.03-3.1	Refl				x	MP	R	also emissivity 400-850 K
LO Unpl	0.12-30		4.2 K for $h\nu < 4.4$ eV RT for $h\nu > 4.4$ eV			x		R; KK: $n,k,\varepsilon_1,\varepsilon_2,$ $\mathrm{Im}(\varepsilon^{-1}),\mu$	absorptivity measured by calorimetry for $h\nu < 4.4$ eV, reflectivity measured for $h\nu > 4.4$ eV

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Zr
Sa39	2.6-27.6	Refl		x			Ex	R	
KC63	0.06-0.5	Ellips				x		n,k	
KC65	0.05-5	Ellips				x	MP,EP	n,k,σ	table λ,n,k
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,-\varepsilon_1$	
LTA66	0.1-3.5						MP	$\varepsilon_2/\lambda,\varepsilon_1$	
Le67	<4						MP	ε_2/λ	data from LT66 and LTA66
VAK67	3-14.4					x		R	polarimetry $3 < h\nu < 5$ eV, reflectance $4 < h\nu < 7$ eV, and photoemission $7.5 < h\nu < 14.4$ eV
GL68	2-5.6	m-θ				x		$\varepsilon_2/\lambda,\varepsilon_1$	
KNB68	5-12	Ellips						R; KK: $\sigma,\mathrm{Im}(\varepsilon^{-1}),$ $\mathrm{Im}(\varepsilon+1)^{-1},-\varepsilon_1$	data from VAK67, KK analyzed
PDS70			1200-2000					ε_H at $\lambda = 6560$ Å	
BaB74			1100-1800			x		ε_N at $\lambda = 6450$ Å	
LOW75	0.15-30	Refl	4.2 K for $h\nu < 4.4$ eV RT for $h\nu > 4.4$ eV				EP	A,R; KK: $\varepsilon_1,\varepsilon_2,\sigma,$ $\mathrm{Im}(\varepsilon^{-1}),\mathrm{Im}(\varepsilon+1)^{-1}$	absorptivity measured by calorimetry $h\nu < 4.4$ eV, reflectivity measured $h\nu > 4.4$ eV
WO76	20-250	Trans		x			Ex	μ	optical absorption, synchrotron radition

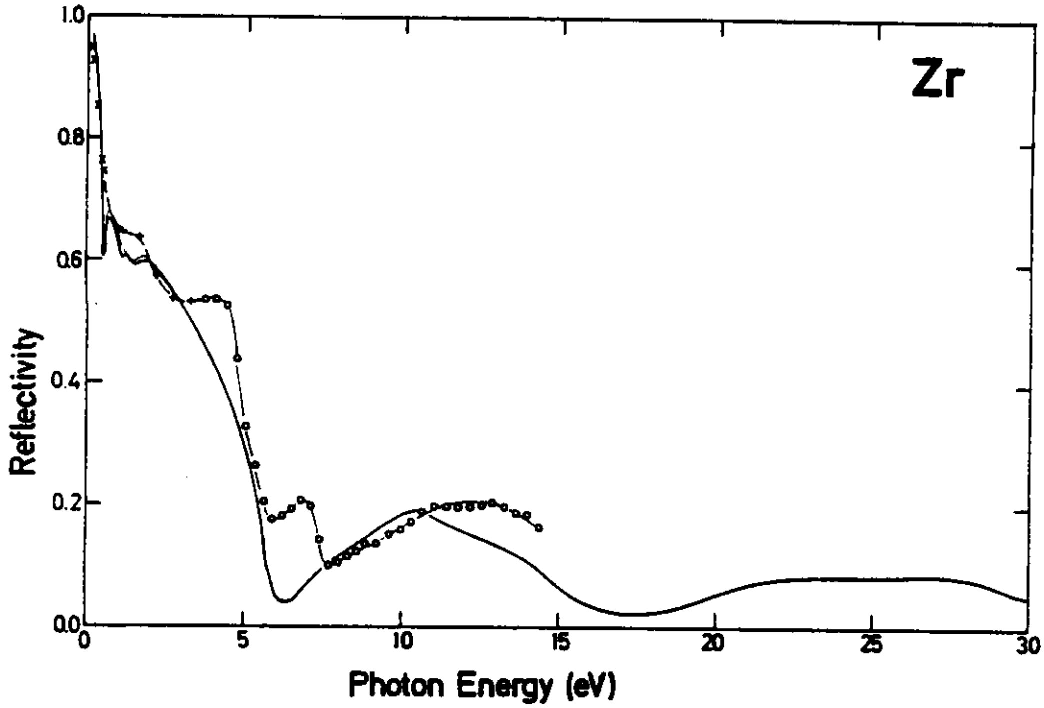

Fig. 39 Reflectivity of Zr. —— LOW75; thin solid line denotes R(E) for single crystal, $\vec{E} \perp \vec{c}$ by LOW (unpub); -o- VAK67; xxx KC63; +++ KN868.

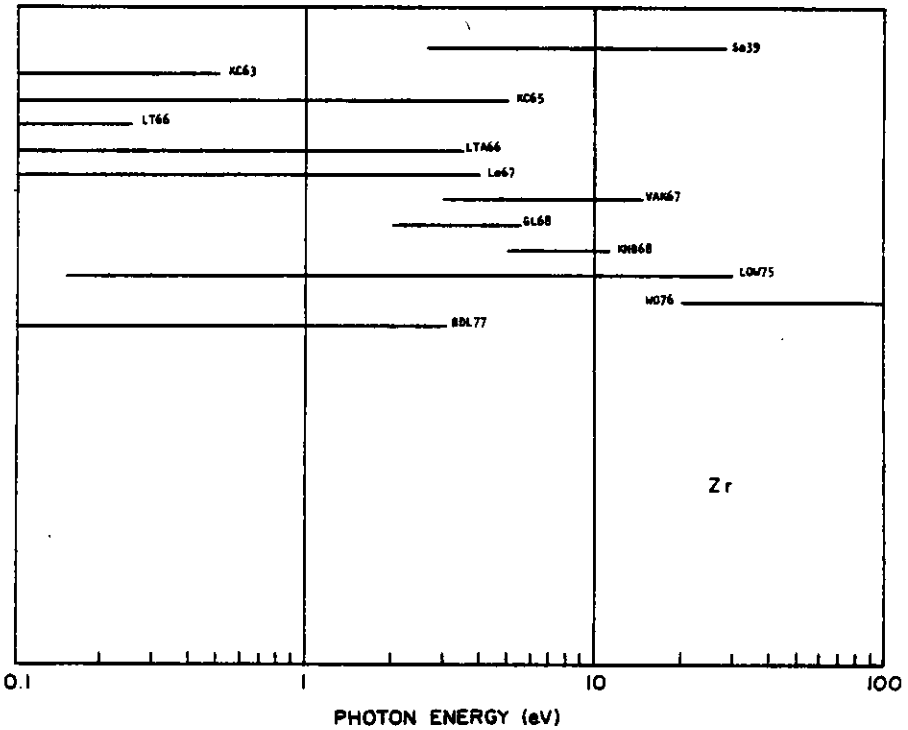

Fig. 38 Survey of available data for Zr

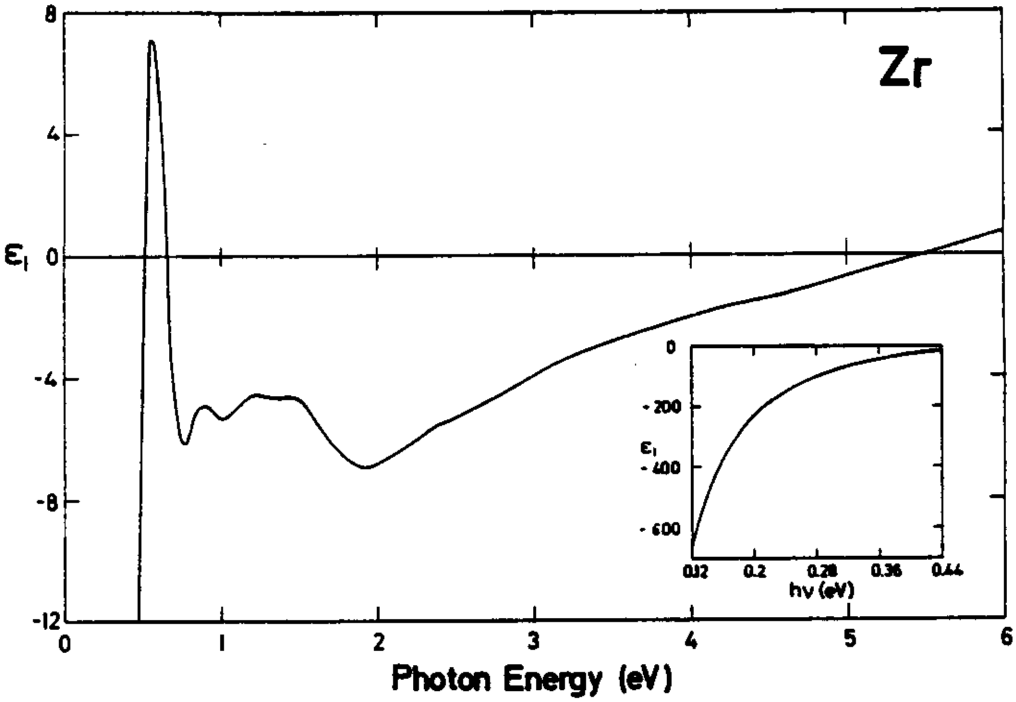

Fig. 40b ϵ_1 for Zr. LOW (unpub) for single crystal Zr with $\vec{E}\perp\hat{c}$.

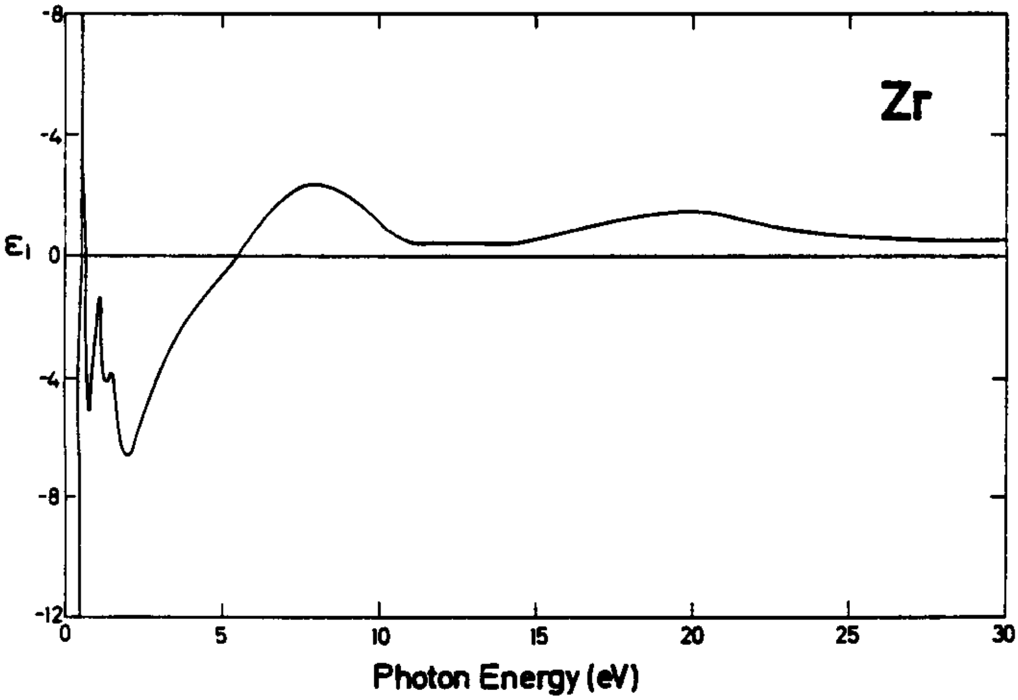

Fig. 40a ϵ_1 for polycrystalline Zr reported by LOW75.

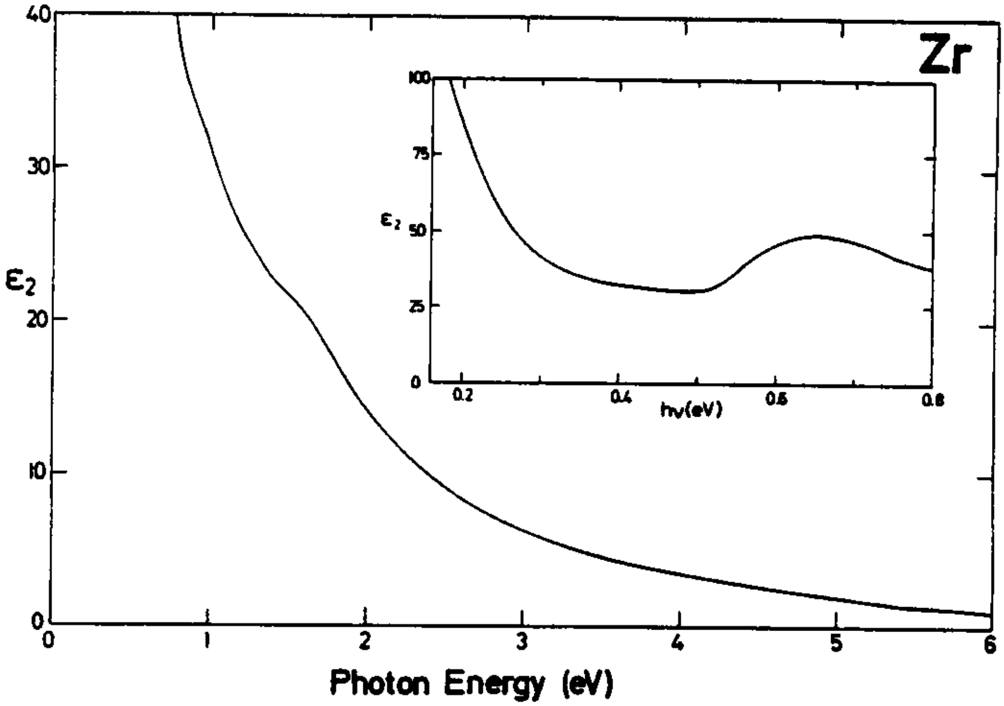

Fig. 41b ε_2 for Zr. LOW (unpub) for single crystal Zr with $\vec{E}\perp\hat{c}$.

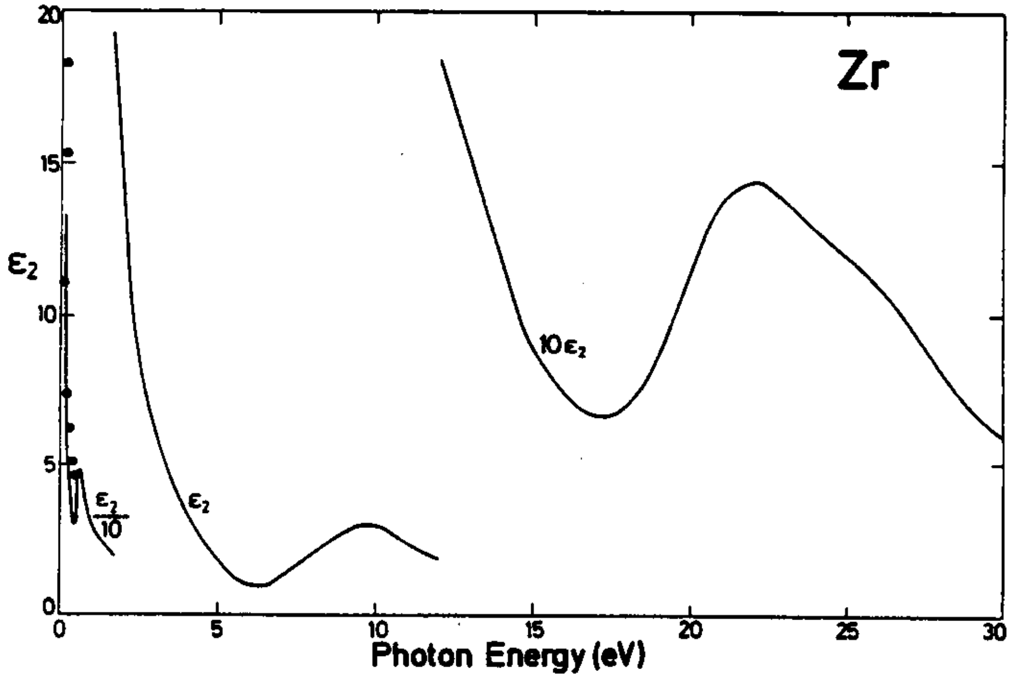

Fig. 41a ε_2 for polycrystalline Zr. —— LOW75; ●●● KC63.

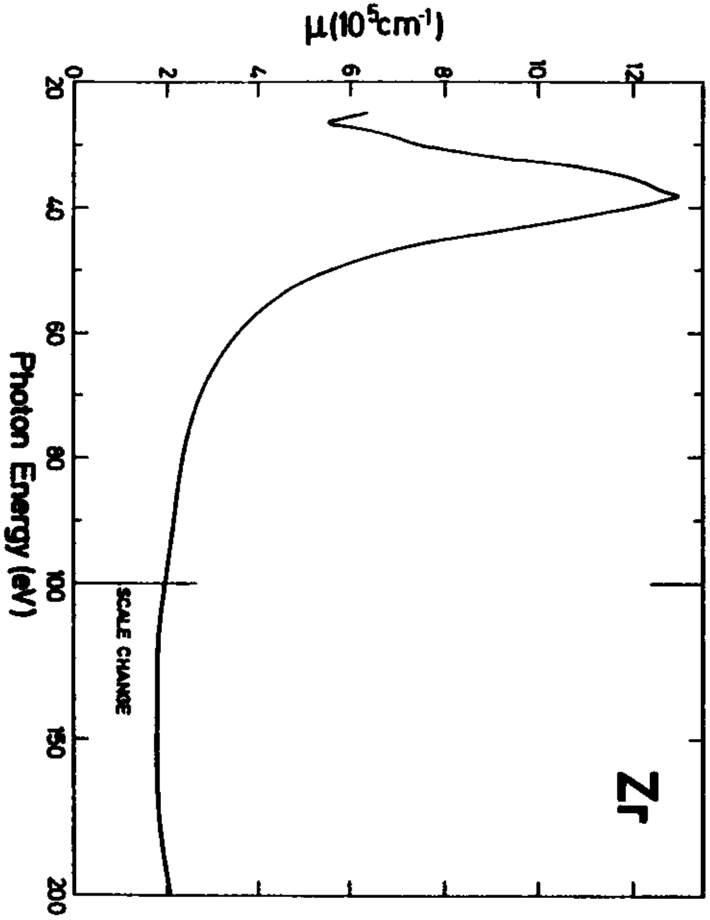

Fig. 42 Absorption coefficient for Zr reported by WO76.

Zirconium

polycrystalline results as published in D.W. Lynch, C.G. Olson, and J.H. Weaver, Phys. Rev. B 11, 3617 (1975)

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε̃)	R(φ=0)
0.10	-812.14	360.46	6.18	1.76	0.00	.300
0.15	-376.96	132.86	3.37	1.30	0.00	.123
0.17	-269.76	90.19	2.71	1.16	0.00	.080
0.20	-196.79	66.55	2.34	1.08	0.00	.058
0.22	-154.08	56.06	2.22	1.05	0.00	.051
0.24	-121.81	49.19	2.19	1.05	0.00	.049
0.26	-96.52	45.07	2.24	1.06	0.00	.052
0.28	-76.58	42.87	2.36	1.09	0.01	.059
0.30	-60.81	42.57	2.59	1.14	0.01	.073
0.32	-49.05	43.24	2.86	1.20	0.01	.090
0.34	-41.04	43.66	3.07	1.24	0.01	.104
0.36	-35.74	42.96	3.17	1.26	0.01	.110
0.38	-31.69	40.74	3.16	1.26	0.02	.109
0.40	-27.38	37.54	3.09	1.24	0.02	.105
0.41	-24.86	35.67	3.05	1.24	0.02	.102
0.42	-21.99	33.98	3.04	1.23	0.02	.101
0.43	-18.89	32.64	3.07	1.24	0.02	.103
0.44	-15.75	31.66	3.13	1.25	0.03	.108
0.45	-12.65	31.01	3.23	1.27	0.03	.114
0.46	-9.60	30.67	3.36	1.30	0.03	.123
0.47	-6.63	30.63	3.51	1.33	0.03	.133
0.48	-3.76	30.92	3.70	1.36	0.03	.146
0.49	-1.02	31.68	3.92	1.40	0.03	.160
0.50	1.32	32.72	4.13	1.44	0.03	.175
0.52	4.70	35.20	4.48	1.50	0.03	.198
0.54	7.05	38.05	4.78	1.55	0.03	.217
0.56	8.13	41.19	5.01	1.58	0.02	.231
0.58	8.00	44.10	5.14	1.60	0.02	.240
0.60	6.59	46.56	5.18	1.61	0.02	.242
0.61	5.46	47.34	5.15	1.61	0.02	.240
0.62	4.30	47.74	5.11	1.60	0.02	.238
0.63	3.18	47.91	5.06	1.59	0.02	.235
0.64	2.05	47.93	5.00	1.58	0.02	.231
0.65	0.89	47.76	4.93	1.57	0.02	.227
0.66	-0.26	47.32	4.85	1.56	0.02	.221
0.68	-1.97	45.95	4.69	1.53	0.02	.211
0.70	-3.18	44.34	4.54	1.51	0.02	.202
0.72	-3.87	42.68	4.41	1.49	0.02	.193
0.74	-4.34	41.19	4.31	1.47	0.02	.186
0.76	-4.65	39.76	4.21	1.45	0.02	.180
0.78	-4.76	38.45	4.12	1.44	0.03	.174
0.80	-5.10	37.23	4.03	1.42	0.03	.168
0.82	-5.09	35.79	3.94	1.40	0.03	.162
0.84	-4.99	34.48	3.86	1.39	0.03	.157
0.86	-4.50	33.25	3.81	1.38	0.03	.153
0.88	-4.14	32.40	3.79	1.37	0.03	.151
0.90	-3.79	31.58	3.74	1.37	0.03	.149
0.92	-3.41	30.86	3.72	1.36	0.03	.147
0.94	-3.03	30.26	3.70	1.36	0.03	.146

Zr

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
0.96	-2.71	29.76	3.69	1.36	0.03	.145
0.98	-2.44	29.32	3.67	1.36	0.03	.144
1.00	-2.19	28.91	3.66	1.35	0.03	.143
1.02	-1.92	28.56	3.65	1.35	0.03	.143
1.04	-1.69	28.29	3.65	1.35	0.04	.142
1.06	-1.47	28.10	3.65	1.35	0.04	.142
1.08	-1.38	28.02	3.65	1.35	0.04	.142
1.10	-1.32	27.95	3.65	1.35	0.04	.142
1.12	-1.43	27.95	3.64	1.35	0.04	.142
1.14	-1.65	27.88	3.62	1.35	0.04	.141
1.16	-1.91	27.74	3.60	1.34	0.04	.139
1.18	-2.19	27.57	3.57	1.34	0.04	.137
1.20	-2.57	27.39	3.53	1.33	0.04	.134
1.22	-3.02	27.07	3.48	1.32	0.04	.131
1.24	-3.45	26.62	3.42	1.31	0.04	.127
1.26	-3.75	26.05	3.36	1.30	0.04	.123
1.28	-3.96	25.46	3.30	1.28	0.04	.119
1.30	-4.07	24.88	3.25	1.27	0.04	.116
1.32	-4.10	24.33	3.21	1.27	0.04	.112
1.34	-4.05	23.84	3.17	1.26	0.04	.110
1.36	-4.01	23.43	3.14	1.25	0.04	.108
1.38	-3.90	23.06	3.12	1.25	0.04	.107
1.40	-3.83	22.79	3.10	1.25	0.04	.106
1.42	-3.81	22.57	3.09	1.24	0.04	.105
1.44	-3.82	22.34	3.07	1.24	0.04	.103
1.46	-3.83	22.13	3.05	1.24	0.04	.102
1.48	-3.85	21.96	3.04	1.23	0.04	.101
1.50	-3.92	21.82	3.02	1.23	0.04	.100
1.52	-4.06	21.69	3.00	1.22	0.04	.099
1.54	-4.24	21.53	2.98	1.22	0.04	.097
1.56	-4.43	21.33	2.95	1.21	0.04	.095
1.58	-4.63	21.10	2.91	1.21	0.05	.093
1.60	-4.83	20.85	2.88	1.20	0.05	.091
1.62	-5.03	20.59	2.84	1.19	0.05	.089
1.64	-5.23	20.30	2.80	1.18	0.05	.086
1.66	-5.43	19.99	2.76	1.18	0.05	.083
1.68	-5.60	19.66	2.72	1.17	0.05	.081
1.70	-5.76	19.32	2.68	1.16	0.05	.078
1.72	-5.90	18.98	2.64	1.15	0.05	.076
1.74	-6.02	18.63	2.60	1.14	0.05	.073
1.76	-6.11	18.23	2.56	1.13	0.05	.071
1.78	-6.22	17.95	2.53	1.12	0.05	.069
1.80	-6.31	17.61	2.49	1.12	0.05	.067
1.85	-6.49	16.76	2.40	1.09	0.05	.061
1.90	-6.59	15.92	2.31	1.07	0.05	.056
1.95	-6.63	15.12	2.22	1.05	0.06	.051
2.00	-6.64	14.36	2.14	1.03	0.06	.047
2.05	-6.60	13.61	2.06	1.02	0.06	.043
2.10	-6.51	12.89	1.99	1.00	0.06	.040
2.15	-6.36	12.22	1.93	0.98	0.06	.036
2.20	-6.17	11.62	1.87	0.97	0.07	.034
2.25	-5.97	11.09	1.82	0.95	0.07	.032
2.30	-5.76	10.64	1.78	0.94	0.07	.030
2.35	-5.59	10.21	1.74	0.93	0.08	.029
2.40	-5.45	9.86	1.71	0.92	0.08	.027
2.45	-5.31	9.49	1.67	0.91	0.08	.026
2.50	-5.24	9.12	1.62	0.90	0.08	.024

Zr

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
2.55	-5.13	8.76	1.58	0.89	0.09	.023
2.60	-5.03	8.39	1.54	0.88	0.09	.022
2.65	-4.91	8.03	1.50	0.87	0.09	.020
2.70	-4.76	7.69	1.46	0.86	0.09	.019
2.75	-4.61	7.37	1.43	0.85	0.10	.018
2.80	-4.45	7.08	1.40	0.84	0.10	.018
2.85	-4.30	6.80	1.37	0.83	0.11	.017
2.90	-4.13	6.54	1.34	0.82	0.11	.016
2.95	-3.97	6.31	1.32	0.81	0.11	.016
3.00	-3.81	6.11	1.30	0.81	0.12	.016
3.10	-3.55	5.74	1.26	0.80	0.13	.015
3.20	-3.32	5.40	1.23	0.78	0.13	.014
3.30	-3.11	5.08	1.19	0.77	0.14	.014
3.40	-2.91	4.79	1.16	0.76	0.15	.013
3.50	-2.73	4.52	1.13	0.75	0.16	.013
3.60	-2.56	4.26	1.10	0.74	0.17	.013
3.70	-2.40	4.02	1.07	0.73	0.18	.013
3.80	-2.25	3.79	1.04	0.72	0.20	.012
3.90	-2.10	3.57	1.01	0.71	0.21	.012
4.00	-1.95	3.36	0.98	0.70	0.22	.012
4.10	-1.81	3.17	0.96	0.69	0.24	.012
4.20	-1.67	2.99	0.94	0.68	0.25	.013
4.30	-1.55	2.82	0.91	0.68	0.27	.013
4.40	-1.42	2.65	0.89	0.67	0.29	.013
4.50	-1.30	2.48	0.87	0.66	0.32	.013
4.60	-1.17	2.33	0.85	0.65	0.34	.014
4.70	-1.05	2.19	0.83	0.64	0.37	.014
4.80	-0.93	2.04	0.81	0.64	0.41	.014
4.90	-0.80	1.90	0.79	0.63	0.45	.015
5.00	-0.67	1.77	0.78	0.63	0.49	.015
5.10	-0.54	1.66	0.78	0.62	0.54	.015
5.20	-0.42	1.54	0.77	0.62	0.60	.016
5.30	-0.28	1.42	0.76	0.62	0.68	.016
5.40	-0.14	1.31	0.77	0.62	0.75	.016
5.50	0.00	1.22	0.78	0.62	0.82	.015
5.60	0.14	1.14	0.80	0.63	0.86	.014
5.70	0.29	1.06	0.83	0.65	0.88	.014
5.80	0.43	0.99	0.87	0.66	0.85	.013
5.90	0.63	0.92	0.93	0.68	0.74	.013
6.00	0.80	0.90	1.00	0.71	0.62	.012
6.10	0.95	0.90	1.06	0.73	0.53	.013
6.20	1.08	0.90	1.11	0.75	0.46	.013
6.30	1.23	0.90	1.17	0.77	0.39	.014
6.40	1.36	0.92	1.23	0.78	0.34	.014
6.50	1.49	0.95	1.28	0.80	0.30	.015
6.60	1.62	0.98	1.33	0.81	0.27	.016
6.70	1.75	1.03	1.37	0.83	0.25	.017
6.80	1.86	1.09	1.42	0.84	0.23	.018
6.90	1.97	1.17	1.46	0.85	0.22	.019
7.00	2.05	1.26	1.49	0.86	0.22	.020
7.20	2.17	1.43	1.54	0.88	0.21	.022
7.40	2.25	1.59	1.58	0.89	0.21	.023
7.60	2.30	1.74	1.61	0.90	0.21	.024
7.80	2.34	1.88	1.63	0.90	0.21	.025
8.00	2.37	2.04	1.66	0.91	0.21	.026
8.20	2.36	2.20	1.67	0.91	0.21	.026
8.40	2.32	2.37	1.68	0.92	0.22	.026

Zr

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
8.60	2.24	2.53	1.68	0.92	0.22	.026
8.80	2.14	2.64	1.66	0.91	0.23	.026
9.00	2.03	2.77	1.65	0.91	0.23	.025
9.20	1.88	2.89	1.63	0.90	0.24	.025
9.40	1.71	2.96	1.60	0.89	0.25	.024
9.60	1.53	3.02	1.57	0.89	0.26	.023
9.80	1.33	3.03	1.52	0.87	0.28	.021
10.00	1.12	3.02	1.47	0.86	0.29	.020
10.20	0.91	2.96	1.42	0.84	0.31	.018
10.40	0.71	2.84	1.35	0.82	0.33	.016
10.50	0.63	2.77	1.32	0.81	0.34	.016
10.60	0.56	2.67	1.28	0.80	0.36	.015
10.80	0.48	2.50	1.23	0.78	0.39	.014
11.00	0.44	2.35	1.19	0.77	0.41	.014
11.20	0.42	2.22	1.16	0.76	0.43	.013
11.40	0.41	2.10	1.13	0.75	0.46	.013
11.60	0.41	2.00	1.11	0.74	0.48	.013
11.80	0.41	1.91	1.09	0.74	0.50	.013
12.00	0.43	1.84	1.08	0.73	0.52	.013
12.20	0.42	1.78	1.06	0.73	0.53	.013
12.40	0.42	1.72	1.05	0.72	0.55	.012
12.60	0.41	1.65	1.03	0.72	0.57	.012
12.80	0.41	1.59	1.01	0.71	0.59	.012
13.00	0.40	1.53	1.00	0.71	0.61	.012
13.20	0.40	1.46	0.98	0.70	0.64	.012
13.40	0.40	1.40	0.96	0.69	0.66	.012
13.60	0.40	1.33	0.95	0.69	0.69	.013
13.80	0.41	1.27	0.93	0.68	0.71	.013
14.00	0.42	1.20	0.92	0.68	0.74	.013
14.20	0.43	1.13	0.91	0.67	0.77	.013
14.40	0.45	1.05	0.89	0.67	0.80	.013
14.60	0.49	0.98	0.89	0.67	0.82	.013
14.80	0.54	0.92	0.90	0.67	0.81	.013
15.00	0.60	0.87	0.91	0.67	0.78	.013
15.20	0.64	0.84	0.92	0.68	0.75	.013
15.40	0.69	0.81	0.94	0.68	0.72	.013
15.60	0.73	0.79	0.95	0.69	0.68	.013
15.80	0.77	0.76	0.96	0.69	0.65	.012
16.00	0.81	0.74	0.98	0.70	0.61	.012
16.20	0.85	0.71	0.99	0.70	0.58	.012
16.40	0.90	0.70	1.01	0.71	0.54	.012
16.60	0.94	0.68	1.02	0.72	0.51	.012
16.80	0.99	0.66	1.04	0.72	0.47	.012
17.00	1.04	0.65	1.06	0.73	0.43	.013
17.20	1.09	0.65	1.09	0.74	0.40	.013
17.40	1.14	0.65	1.11	0.74	0.38	.013
17.60	1.19	0.66	1.13	0.75	0.36	.013
17.80	1.23	0.67	1.15	0.76	0.34	.013
18.00	1.28	0.70	1.17	0.76	0.33	.014
18.20	1.32	0.72	1.19	0.77	0.32	.014
18.40	1.36	0.75	1.21	0.78	0.31	.014
18.60	1.40	0.78	1.23	0.78	0.30	.014
18.80	1.43	0.82	1.24	0.79	0.30	.014
19.00	1.46	0.87	1.26	0.79	0.30	.015
19.20	1.48	0.92	1.27	0.80	0.30	.015
19.40	1.50	0.97	1.28	0.80	0.30	.015
19.60	1.51	1.02	1.29	0.80	0.31	.015

Zr

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
19.80	1.51	1.08	1.30	0.81	0.31	.015
20.00	1.50	1.14	1.30	0.81	0.32	.015
20.20	1.48	1.20	1.30	0.81	0.33	.015
20.40	1.45	1.26	1.30	0.81	0.34	.015
20.60	1.42	1.30	1.29	0.80	0.35	.015
20.80	1.37	1.35	1.28	0.80	0.36	.015
21.00	1.32	1.38	1.27	0.80	0.38	.015
21.20	1.27	1.40	1.26	0.79	0.39	.015
21.40	1.22	1.43	1.24	0.79	0.40	.014
21.60	1.17	1.44	1.23	0.78	0.42	.014
21.80	1.12	1.44	1.21	0.78	0.43	.014
22.00	1.07	1.44	1.20	0.77	0.45	.014
22.20	1.02	1.43	1.18	0.77	0.46	.014
22.40	0.98	1.42	1.16	0.76	0.48	.013
22.60	0.94	1.41	1.15	0.76	0.49	.013
22.80	0.90	1.40	1.13	0.75	0.51	.013
23.00	0.87	1.38	1.12	0.75	0.52	.013
23.20	0.84	1.36	1.10	0.74	0.53	.013
23.40	0.81	1.34	1.09	0.74	0.55	.013
23.60	0.78	1.32	1.08	0.73	0.56	.013
23.80	0.76	1.30	1.06	0.73	0.57	.013
24.00	0.74	1.28	1.05	0.73	0.59	.013
24.20	0.72	1.26	1.04	0.72	0.60	.012
24.40	0.70	1.24	1.03	0.72	0.61	.012
24.60	0.68	1.22	1.02	0.71	0.63	.012
24.80	0.66	1.21	1.01	0.71	0.64	.012
25.00	0.64	1.19	1.00	0.71	0.65	.012
25.20	0.62	1.17	0.99	0.70	0.67	.012
25.40	0.61	1.15	0.98	0.70	0.69	.012
25.60	0.59	1.13	0.97	0.69	0.70	.012
25.80	0.57	1.11	0.95	0.69	0.71	.012
26.00	0.56	1.10	0.95	0.69	0.72	.013
26.20	0.54	1.08	0.93	0.68	0.74	.013
26.40	0.52	1.06	0.92	0.68	0.76	.013
26.60	0.50	1.03	0.91	0.67	0.79	.013
26.80	0.48	1.01	0.89	0.67	0.81	.013
27.00	0.46	0.98	0.88	0.66	0.84	.013
27.20	0.45	0.94	0.86	0.66	0.87	.013
27.40	0.44	0.90	0.85	0.65	0.90	.014
27.60	0.44	0.87	0.84	0.65	0.92	.014
27.80	0.44	0.83	0.83	0.64	0.94	.014
28.00	0.45	0.80	0.83	0.64	0.95	.014
28.20	0.45	0.78	0.82	0.64	0.96	.014
28.40	0.46	0.75	0.82	0.64	0.97	.014
28.60	0.47	0.73	0.82	0.64	0.97	.014
28.80	0.48	0.70	0.82	0.64	0.97	.014
29.00	0.49	0.68	0.81	0.64	0.97	.014
29.20	0.50	0.66	0.81	0.64	0.96	.014
29.40	0.50	0.64	0.81	0.64	0.97	.014
29.60	0.52	0.62	0.82	0.64	0.95	.014
29.80	0.53	0.60	0.82	0.64	0.94	.014
30.00	0.55	0.59	0.82	0.64	0.91	.014

Zirconium single crystal with $\vec{E}\perp\hat{c}$

D.W. Lynch, C.G. Olson, and J.H. Weaver (unpub)

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.51	-1.68	31.00	3.83	4.05	0.03	.618
0.52	1.01	31.92	4.06	3.93	0.03	.609
0.53	3.43	33.40	4.30	3.88	0.03	.606
0.54	5.37	35.38	4.54	3.90	0.03	.609
0.56	7.12	39.72	4.87	4.08	0.02	.623
0.58	6.94	43.39	5.04	4.30	0.02	.638
0.60	5.81	45.78	5.10	4.49	0.02	.649
0.62	4.19	47.37	5.09	4.66	0.02	.658
0.64	2.28	48.19	5.03	4.79	0.02	.665
0.66	0.21	48.32	4.93	4.90	0.02	.671
0.68	-1.80	47.74	4.79	4.98	0.02	.675
0.70	-3.57	46.59	4.65	5.01	0.02	.678
0.72	-4.91	45.00	4.49	5.01	0.02	.679
0.74	-5.83	43.19	4.34	4.97	0.02	.678
0.76	-6.17	41.31	4.22	4.90	0.02	.674
0.78	-6.16	39.65	4.12	4.81	0.02	.670
0.80	-5.82	38.24	4.05	4.72	0.03	.665
0.82	-5.46	37.19	4.01	4.64	0.03	.660
0.84	-5.14	36.38	3.98	4.58	0.03	.656
0.86	-5.00	35.73	3.94	4.53	0.03	.653
0.88	-4.93	35.09	3.91	4.49	0.03	.651
0.90	-4.93	34.46	3.87	4.46	0.03	.649
0.92	-4.94	33.84	3.82	4.42	0.03	.647
0.94	-4.99	33.24	3.78	4.39	0.03	.645
0.96	-5.11	32.64	3.74	4.37	0.03	.644
0.98	-5.27	31.97	3.68	4.34	0.03	.643
1.00	-5.32	31.21	3.63	4.30	0.03	.641
1.05	-5.18	29.53	3.52	4.19	0.03	.634
1.10	-4.95	28.14	3.44	4.09	0.03	.627
1.15	-4.75	26.99	3.37	4.01	0.04	.621
1.20	-4.62	26.01	3.30	3.94	0.04	.616
1.25	-4.58	25.14	3.24	3.88	0.04	.612
1.30	-4.65	24.30	3.17	3.83	0.04	.609
1.35	-4.66	23.44	3.10	3.78	0.04	.605
1.40	-4.63	22.68	3.04	3.73	0.04	.602
1.45	-4.58	22.06	3.00	3.68	0.04	.598
1.50	-4.70	21.59	2.95	3.66	0.04	.597
1.55	-4.96	21.13	2.89	3.65	0.04	.598
1.60	-5.39	20.60	2.82	3.65	0.05	.600
1.65	-5.81	19.90	2.73	3.64	0.05	.602
1.70	-6.18	19.13	2.64	3.63	0.05	.604
1.75	-6.47	18.30	2.54	3.60	0.05	.605
1.80	-6.72	17.45	2.45	3.57	0.05	.606
1.85	-6.90	16.56	2.35	3.52	0.05	.606
1.90	-6.95	15.66	2.26	3.47	0.05	.605
1.95	-6.87	14.83	2.18	3.41	0.06	.603
2.00	-6.77	14.11	2.11	3.35	0.06	.600
2.05	-6.66	13.44	2.04	3.29	0.06	.597
2.10	-6.50	12.79	1.98	3.24	0.06	.595

Zr $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
2.15	-6.41	12.17	1.92	3.18	0.06	.591
2.20	-6.23	11.61	1.86	3.11	0.07	.587
2.25	-6.02	11.10	1.82	3.05	0.07	.583
2.30	-5.83	10.66	1.78	3.00	0.07	.578
2.35	-5.66	10.27	1.74	2.95	0.07	.574
2.40	-5.53	9.90	1.71	2.90	0.08	.571
2.45	-5.41	9.55	1.67	2.86	0.08	.568
2.50	-5.34	9.19	1.63	2.83	0.08	.566
2.55	-5.23	8.81	1.58	2.78	0.08	.564
2.60	-5.12	8.43	1.54	2.74	0.09	.562
2.65	-4.97	8.08	1.50	2.69	0.09	.558
2.70	-4.83	7.75	1.47	2.64	0.09	.554
2.75	-4.67	7.44	1.43	2.59	0.10	.550
2.90	-4.20	6.64	1.35	2.46	0.11	.535
2.95	-4.05	6.41	1.33	2.41	0.11	.530
3.00	-3.90	6.20	1.31	2.37	0.12	.524
3.10	-3.63	5.83	1.27	2.29	0.12	.514
3.20	-3.40	5.48	1.24	2.22	0.13	.504
3.30	-3.18	5.17	1.20	2.15	0.14	.495
3.40	-2.99	4.88	1.17	2.09	0.15	.486
3.50	-2.81	4.60	1.14	2.02	0.16	.478
3.60	-2.64	4.34	1.10	1.96	0.17	.469
3.70	-2.48	4.10	1.07	1.91	0.18	.460
3.80	-2.32	3.86	1.05	1.85	0.19	.451
3.90	-2.17	3.64	1.02	1.79	0.20	.442
4.00	-2.03	3.44	0.99	1.73	0.22	.433
4.10	-1.88	3.24	0.97	1.68	0.23	.423
4.20	-1.75	3.06	0.94	1.62	0.25	.412
4.30	-1.62	2.88	0.92	1.57	0.26	.403
4.40	-1.50	2.71	0.89	1.52	0.28	.392
4.50	-1.37	2.55	0.87	1.46	0.30	.380
4.60	-1.24	2.39	0.85	1.40	0.33	.368
4.70	-1.12	2.24	0.83	1.35	0.36	.354
4.80	-0.99	2.09	0.81	1.29	0.39	.340
4.90	-0.87	1.95	0.80	1.23	0.43	.324
5.00	-0.74	1.82	0.78	1.16	0.47	.306
5.10	-0.61	1.70	0.77	1.10	0.52	.286
5.20	-0.48	1.58	0.77	1.03	0.58	.264
5.30	-0.34	1.46	0.76	0.96	0.65	.239
5.40	-0.20	1.36	0.77	0.89	0.72	.211
5.50	-0.05	1.26	0.78	0.81	0.79	.181
5.60	0.09	1.18	0.80	0.74	0.84	.150
5.70	0.24	1.10	0.83	0.67	0.87	.121
5.80	0.40	1.03	0.87	0.59	0.85	.093
5.90	0.56	0.97	0.92	0.53	0.77	.070
6.00	0.73	0.93	0.98	0.47	0.66	.053
6.10	0.89	0.92	1.04	0.44	0.56	.045
6.20	1.04	0.92	1.10	0.42	0.48	.041
6.30	1.18	0.92	1.16	0.40	0.41	.040
6.40	1.31	0.93	1.21	0.39	0.36	.040
6.50	1.45	0.96	1.26	0.38	0.32	.043
6.60	1.58	0.99	1.31	0.38	0.29	.047
6.70	1.70	1.04	1.36	0.38	0.26	.051
6.80	1.82	1.10	1.41	0.39	0.24	.057
6.90	1.93	1.17	1.45	0.41	0.23	.063
7.00	2.01	1.25	1.48	0.42	0.22	.068
7.20	2.15	1.41	1.54	0.46	0.21	.079

Zr $\vec{E}\perp\hat{c}$

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
7.40	2.24	1.57	1.58	0.50	0.21	.089
7.60	2.30	1.72	1.61	0.53	0.21	.097
7.80	2.35	1.87	1.64	0.57	0.21	.105
8.00	2.38	2.03	1.66	0.61	0.21	.113
8.20	2.38	2.19	1.68	0.65	0.21	.121
8.40	2.35	2.36	1.68	0.70	0.21	.129
8.60	2.28	2.51	1.68	0.75	0.22	.136
8.80	2.19	2.66	1.68	0.79	0.22	.144
9.00	2.08	2.79	1.67	0.84	0.23	.150
9.20	1.94	2.91	1.65	0.88	0.24	.158
9.40	1.77	3.00	1.62	0.93	0.25	.164
10.00	1.18	3.08	1.50	1.03	0.28	.183
10.20	0.96	3.03	1.44	1.05	0.30	.187
10.40	0.75	2.93	1.37	1.07	0.32	.191
10.50	0.66	2.85	1.34	1.06	0.33	.191
10.60	0.59	2.76	1.31	1.06	0.35	.190
10.80	0.50	2.59	1.25	1.03	0.37	.186
11.00	0.45	2.44	1.21	1.01	0.40	.181
11.20	0.42	2.30	1.17	0.98	0.42	.175
11.40	0.41	2.18	1.15	0.95	0.44	.169
11.60	0.40	2.08	1.12	0.93	0.46	.163
11.80	0.41	1.99	1.10	0.90	0.48	.157
12.00	0.41	1.91	1.09	0.88	0.50	.152
12.20	0.41	1.85	1.07	0.86	0.52	.148
12.40	0.40	1.78	1.06	0.84	0.53	.145
12.60	0.39	1.72	1.04	0.83	0.55	.141
12.80	0.39	1.65	1.02	0.81	0.57	.137
13.00	0.38	1.59	1.00	0.79	0.60	.133
13.20	0.38	1.52	0.99	0.77	0.62	.130
13.40	0.38	1.45	0.97	0.75	0.64	.125
13.60	0.38	1.39	0.95	0.73	0.67	.120
13.80	0.38	1.32	0.94	0.70	0.70	.115
14.00	0.39	1.25	0.92	0.68	0.73	.109
14.20	0.40	1.17	0.91	0.65	0.76	.103
14.40	0.43	1.10	0.90	0.61	0.79	.094
14.60	0.46	1.03	0.89	0.58	0.81	.085
14.80	0.51	0.96	0.89	0.54	0.81	.075
15.00	0.56	0.91	0.90	0.51	0.79	.066
15.20	0.61	0.88	0.92	0.48	0.77	.058
15.40	0.66	0.84	0.93	0.45	0.74	.052
15.60	0.70	0.81	0.94	0.43	0.71	.047
15.80	0.74	0.79	0.95	0.41	0.68	.042
16.00	0.78	0.76	0.97	0.39	0.64	.037
16.20	0.82	0.73	0.98	0.37	0.60	.034
16.40	0.87	0.71	1.00	0.36	0.57	.030
16.60	0.91	0.70	1.01	0.34	0.53	.028
16.80	0.96	0.68	1.03	0.33	0.49	.026
17.00	1.01	0.67	1.05	0.32	0.46	.024
17.20	1.06	0.66	1.07	0.31	0.42	.023
17.40	1.11	0.66	1.10	0.30	0.39	.023
17.60	1.16	0.67	1.12	0.30	0.37	.024
17.80	1.21	0.68	1.14	0.30	0.35	.025
18.00	1.26	0.70	1.16	0.30	0.34	.026
18.20	1.31	0.72	1.18	0.30	0.32	.028
18.40	1.35	0.75	1.20	0.31	0.31	.030
18.60	1.39	0.78	1.22	0.32	0.31	.032
18.80	1.43	0.82	1.24	0.33	0.30	.035

Zr $\vec{E}\perp\hat{c}$

Energy (eV)	ε_1	ε_2	n	k	$\mathrm{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
19.00	1.46	0.86	1.26	0.34	0.30	.038
19.20	1.49	0.91	1.27	0.36	0.30	.041
19.40	1.51	0.96	1.28	0.37	0.30	.044
19.60	1.52	1.02	1.29	0.39	0.30	.047
19.80	1.53	1.08	1.30	0.41	0.31	.051
20.00	1.52	1.14	1.31	0.43	0.31	.054
20.20	1.51	1.20	1.31	0.46	0.32	.058
20.40	1.48	1.25	1.31	0.48	0.33	.061
21.20	1.33	1.43	1.28	0.56	0.38	.073
21.40	1.27	1.45	1.27	0.57	0.39	.075
21.60	1.22	1.47	1.25	0.59	0.40	.077
21.80	1.16	1.48	1.23	0.60	0.42	.079
22.00	1.11	1.48	1.22	0.61	0.43	.080
22.20	1.07	1.48	1.20	0.62	0.44	.082
22.40	1.02	1.48	1.19	0.62	0.46	.083
22.60	0.98	1.47	1.17	0.63	0.47	.084
22.80	0.94	1.45	1.15	0.63	0.49	.084
23.00	0.90	1.44	1.14	0.63	0.50	.085
23.20	0.87	1.42	1.13	0.63	0.51	.085
23.40	0.83	1.41	1.11	0.63	0.53	.085
23.60	0.80	1.39	1.10	0.63	0.54	.085
23.80	0.78	1.37	1.08	0.63	0.55	.085
24.00	0.76	1.35	1.07	0.63	0.56	.085
24.20	0.73	1.33	1.06	0.63	0.58	.085
24.40	0.71	1.31	1.05	0.62	0.59	.085
24.60	0.69	1.29	1.04	0.62	0.60	.085
24.80	0.67	1.28	1.03	0.62	0.61	.085

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Nb
				Film	X-tal	Bulk	Prep		
KN78	0.07-4.66	Ellips			x		EP	$n,k,\sigma,\varepsilon_1,\varepsilon_2$	table λ,n,k
TLT78	6.6-23	m-θ				x	Heat	$R,\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	foil heated to 2000 K in uhv
GCS79	0.32-5.6	Trans, Refl		x			In	σ	uhv
NC80	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	substrate 975-1175 K
NCC80	0.5-6.5	Trans, Refl		x			Ex	σ	
LA Unpl	1.5-5.5	Ellips		x				$\varepsilon_1,\varepsilon_2,n,k,R,\mu$	private communication
KNB68	5-12	Ellips						R; KK: $\sigma,\mathrm{Im}(\varepsilon^{-1})$, $\mathrm{Im}(\varepsilon+1)^{-1}$	KK analyzed data from VAK67

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Nb
				Film	X-tal	Bulk	Prep		
KC65	0.05-5	Ellips				x		n,k,σ	
AU66	~2.5-55	Trans	~2000			x	Heat	$\mathrm{Im}(\varepsilon^{-1})$	energy loss spectroscopy at several temperatures
Ba66	0.6-2.6	Ellips				x		n,k	filamentary samples at several temperatures
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
Le67	0.1-4	Ellips				x	MP	ε_2/λ	data from LT66 and LTA66
VAK67	3-14.4					x	Ex	R	polarimetry $3 < h\nu < 5$ eV, reflectance $4 < h\nu < 7$ eV, photoemission $7.5 < h\nu < 14.4$ eV
GLM69	0.12-3.1	Ellips	4.2, 78, 293			x	EP	n,k	plotted RT data, table λ,n,k
WL073	0.1-36.4	Refl	4.2 K for $h\nu < 4.5$ eV RT for $h\nu > 4.5$ eV		x		EP	A,R; KK: $\varepsilon_1,\varepsilon_2$, $\mathrm{Im}(\varepsilon^{-1})$	absorptivity measured by calorimetry $h\nu \le 4.5$ eV, reflectance $h\nu \ge 5$ eV with synchrotron radiation. See also RCF80 and BL077
SCG75	0.32-5.5	Trans, Refl		x			In	σ	uhv evaporation
SCGP75	0.32-5.5	Trans		x			In	T	uhv evaporation
CGS76	0.32-5.5	Trans, Refl		x			In	σ	uhv evaporation
W076	20-250			x			Ex	μ	optical absorption measurements with synchrotron radiation
BDL77	0.03-3.1	Refl				x	MP	R	also emissivity 400-850 K

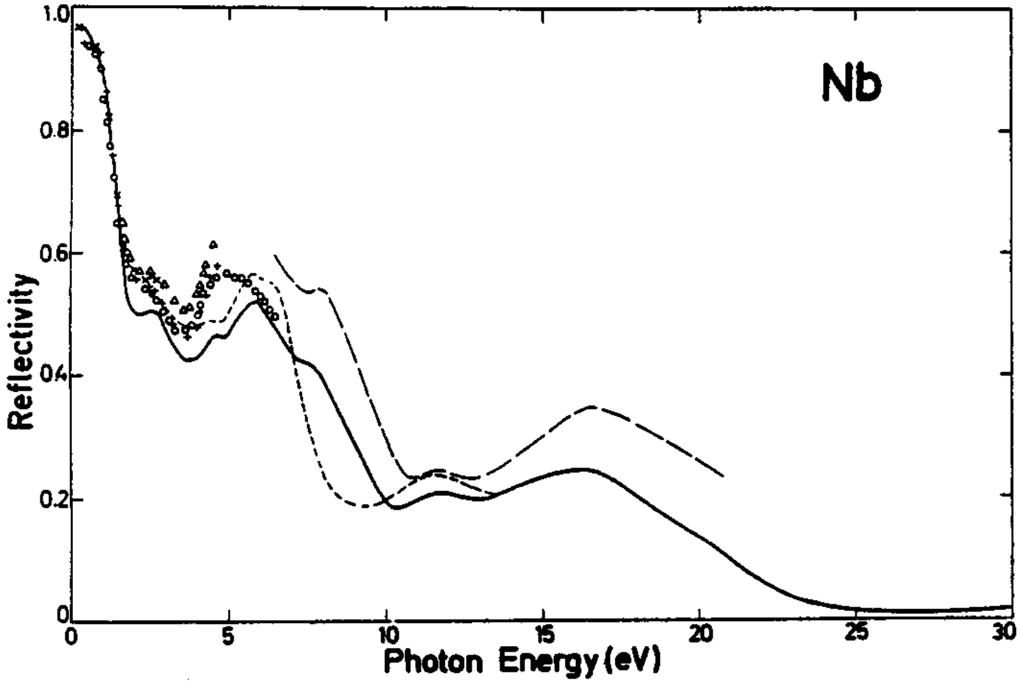

Fig. 44 Reflectivity of Nb. —— WL073; --- VAK67; — — TLT78; xxx GLM69; +++ KN78; ooo NC80; ΔΔΔ LA unpub.

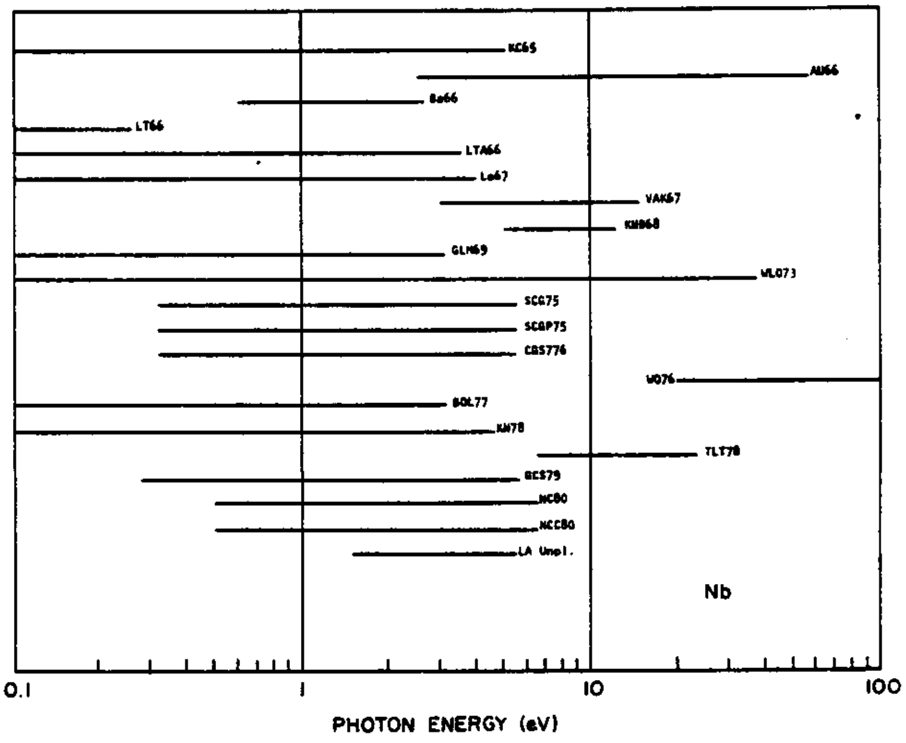

Fig. 43 Survey of available data for Nb

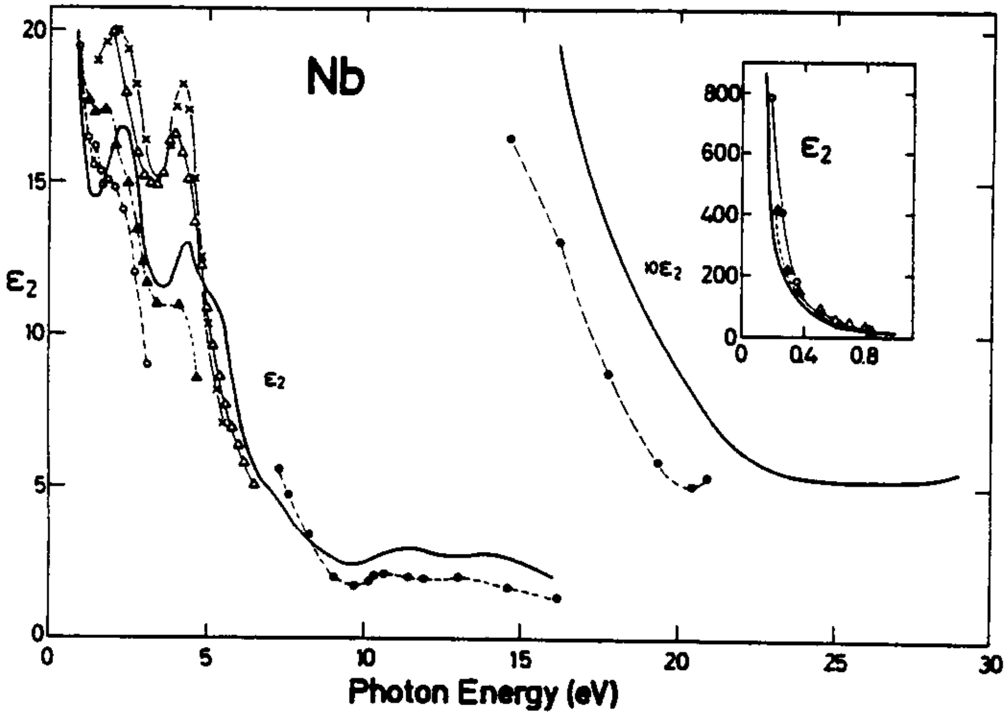

Fig. 46 ε_2 for Nb. —— WL073; ●●● TLT78; ooo GLM69; ΔΔΔ NC80; ▲▲▲ KN78; xxx LA unpub.

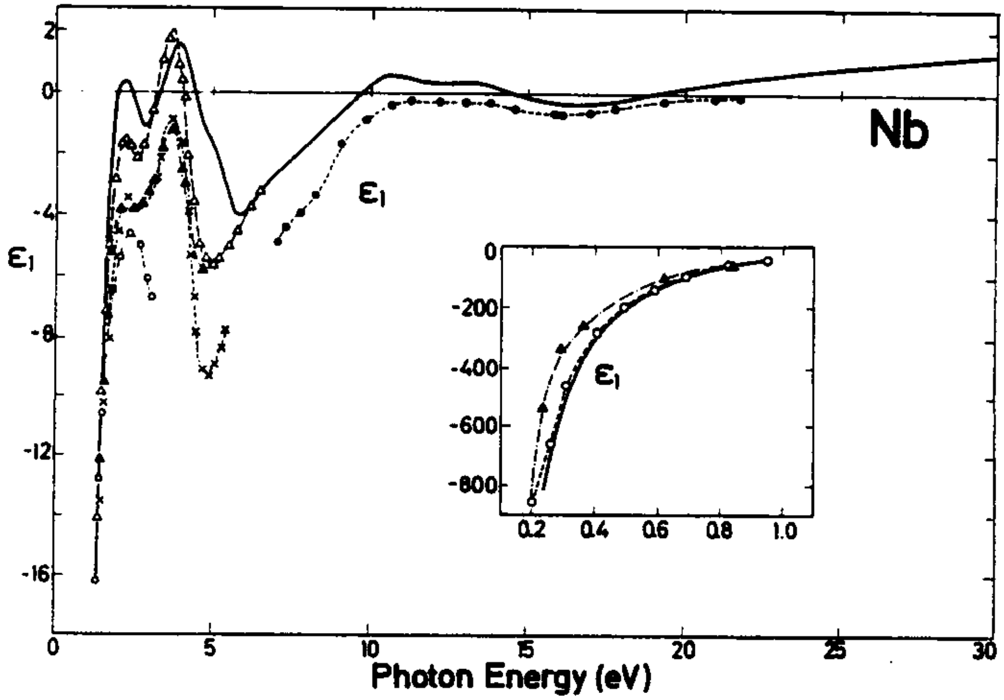

Fig. 45 ε_1 for Nb. —— WL073; ●●● TLT78; ooo GLM69; ΔΔΔ NC80; ▲▲▲ KN78; xxx LA unpub.

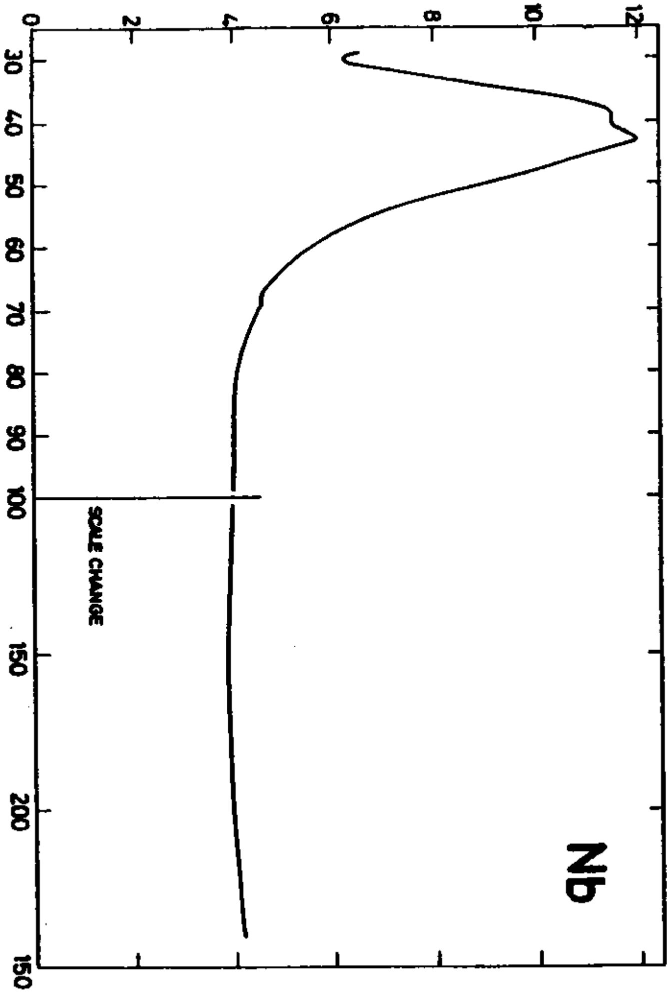

Fig. 47 Absorption coefficient for Nb reported by WO76.

Niobium

publication by J.H. Weaver, D.W. Lynch, and C.G. Olson in Phys. Rev. B 7, 4311 (1973) based on the following tabulation

Energy (eV)	ε_1	ε_2	n	k	Im(-1/$\tilde{\varepsilon}$)	R(ϕ=0)
0.12	-2574.77	1701.03	15.99	53.20	0.00	.979
0.16	-1630.82	853.53	10.24	41.66	0.00	.978
0.20	-1112.83	494.79	7.25	34.14	0.00	.976
0.24	-803.81	316.12	5.47	28.88	0.00	.975
0.28	-604.16	212.42	4.26	24.95	0.00	.974
0.35	-391.64	124.40	3.11	20.03	0.00	.970
0.45	-237.62	71.15	2.28	15.58	0.00	.964
0.55	-157.19	46.47	1.83	12.67	0.00	.956
0.65	-109.67	33.33	1.57	10.59	0.00	.947
0.75	-79.07	25.42	1.41	9.00	0.00	.935
0.85	-58.04	20.87	1.35	7.74	0.01	.918
0.95	-43.10	18.09	1.35	6.70	0.01	.893
1.05	-32.21	16.84	1.44	5.86	0.01	.857
1.15	-24.44	16.08	1.55	5.18	0.02	.814
1.25	-18.68	15.25	1.65	4.63	0.03	.768
1.35	-13.97	14.51	1.76	4.13	0.04	.715
1.45	-9.78	14.37	1.95	3.68	0.05	.650
1.55	-6.68	14.49	2.15	3.37	0.06	.595
1.65	-4.21	14.77	2.36	3.13	0.06	.552
1.75	-2.51	15.17	2.54	2.99	0.06	.527
1.85	-1.09	15.56	2.69	2.89	0.06	.519
1.95	-0.25	16.13	2.82	2.86	0.06	.505
2.05	0.12	16.56	2.89	2.87	0.06	.505
2.15	0.29	16.75	2.92	2.87	0.06	.505
2.25	0.32	16.83	2.93	2.87	0.06	.505
2.35	0.24	16.83	2.92	2.88	0.06	.506
2.45	-0.04	16.78	2.89	2.90	0.06	.509
2.55	-0.52	16.52	2.83	2.92	0.06	.512
2.65	-0.90	15.93	2.74	2.90	0.06	.511
2.75	-1.14	15.22	2.66	2.86	0.07	.507
2.85	-1.16	14.43	2.58	2.80	0.07	.500
3.00	-0.88	13.43	2.51	2.68	0.07	.485
3.10	-0.65	12.90	2.48	2.60	0.08	.475
3.20	-0.40	12.42	2.45	2.53	0.08	.465
3.30	-0.04	11.98	2.44	2.45	0.08	.453
3.40	0.39	11.71	2.46	2.38	0.09	.442
3.50	0.72	11.59	2.48	2.33	0.09	.435
3.60	1.10	11.51	2.52	2.29	0.09	.428
3.70	1.38	11.63	2.56	2.27	0.09	.426
3.80	1.52	11.81	2.59	2.28	0.08	.427
3.90	1.61	12.00	2.62	2.29	0.09	.429
4.00	1.57	12.29	2.64	2.33	0.08	.434
4.20	1.10	12.78	2.64	2.42	0.09	.447
4.40	-0.12	12.95	2.53	2.56	0.08	.467
4.60	-0.94	12.21	2.39	2.56	0.09	.470
4.80	-0.93	11.68	2.32	2.52	0.09	.465
5.00	-1.47	11.62	2.26	2.57	0.08	.475
5.20	-2.20	11.33	2.16	2.62	0.09	.487
5.40	-3.15	10.73	2.00	2.68	0.09	.505

Nb

Energy (eV)	ε_1	ε_2	n	k	Im(-1/$\tilde{\varepsilon}$)	R(ϕ=0)
5.60	-3.85	9.66	1.81	2.67	0.09	.518
5.80	-4.06	8.49	1.63	2.60	0.10	.522
6.00	-4.00	7.45	1.49	2.49	0.10	.520
6.20	-3.75	6.56	1.38	2.38	0.11	.512
6.40	-3.34	5.89	1.31	2.25	0.13	.496
6.60	-3.00	5.40	1.26	2.14	0.14	.480
6.80	-2.63	5.04	1.24	2.04	0.16	.460
7.00	-2.32	4.82	1.23	1.96	0.17	.441
7.20	-2.14	4.67	1.22	1.91	0.18	.430
7.40	-2.10	4.49	1.20	1.88	0.18	.427
7.60	-2.12	4.20	1.14	1.85	0.19	.430
7.80	-2.05	3.80	1.07	1.78	0.20	.428
8.00	-1.82	3.44	1.02	1.69	0.23	.412
8.20	-1.55	3.17	1.00	1.60	0.25	.390
8.40	-1.29	2.98	0.99	1.51	0.28	.365
8.60	-1.06	2.83	0.99	1.43	0.31	.340
8.70	-0.95	2.77	0.99	1.39	0.32	.328
8.80	-0.84	2.71	1.00	1.36	0.34	.315
8.90	-0.73	2.65	1.00	1.32	0.35	.302
9.00	-0.63	2.61	1.01	1.29	0.36	.290
9.10	-0.52	2.57	1.02	1.25	0.37	.277
9.20	-0.42	2.54	1.04	1.22	0.38	.265
9.30	-0.30	2.52	1.06	1.19	0.39	.252
9.40	-0.24	2.52	1.07	1.18	0.39	.245
9.50	-0.15	2.50	1.08	1.15	0.40	.235
9.60	-0.08	2.48	1.10	1.13	0.40	.227
9.70	0.01	2.46	1.11	1.11	0.41	.218
9.80	0.10	2.45	1.13	1.09	0.41	.209
9.90	0.20	2.45	1.15	1.06	0.41	.200
10.00	0.29	2.48	1.18	1.05	0.40	.194
10.10	0.36	2.51	1.20	1.04	0.39	.190
10.20	0.43	2.55	1.23	1.04	0.38	.187
10.30	0.49	2.59	1.25	1.04	0.37	.185
10.40	0.54	2.65	1.27	1.04	0.36	.185
10.50	0.56	2.72	1.29	1.05	0.35	.187
10.60	0.57	2.77	1.30	1.06	0.35	.190
10.70	0.56	2.81	1.31	1.07	0.34	.192
10.80	0.56	2.85	1.32	1.08	0.34	.195
10.90	0.54	2.88	1.32	1.09	0.34	.197
11.00	0.52	2.90	1.32	1.10	0.33	.200
11.10	0.50	2.92	1.32	1.11	0.33	.202
11.20	0.47	2.93	1.31	1.12	0.33	.204
11.30	0.45	2.94	1.31	1.12	0.33	.206
11.40	0.42	2.93	1.30	1.13	0.33	.207
11.60	0.37	2.91	1.28	1.13	0.34	.209
11.80	0.34	2.87	1.27	1.13	0.34	.210
12.00	0.31	2.82	1.25	1.12	0.35	.209
12.20	0.31	2.77	1.25	1.11	0.36	.207
12.40	0.32	2.73	1.24	1.10	0.36	.204
12.60	0.35	2.70	1.24	1.09	0.36	.201
12.80	0.36	2.70	1.24	1.09	0.36	.200
13.00	0.36	2.70	1.24	1.09	0.36	.200
13.20	0.35	2.71	1.24	1.09	0.36	.201
13.40	0.33	2.74	1.24	1.10	0.36	.204
13.60	0.28	2.75	1.23	1.12	0.36	.208
13.80	0.21	2.74	1.22	1.13	0.36	.213
14.00	0.16	2.72	1.20	1.13	0.37	.216

Nb

Energy (eV)	ε_1	ε_2	n	k	Im(-1/$\tilde{\varepsilon}$)	R(ϕ=0)
14.20	0.09	2.70	1.18	1.14	0.37	.220
14.40	0.03	2.67	1.16	1.15	0.37	.225
14.60	-0.04	2.63	1.14	1.15	0.38	.229
14.80	-0.11	2.57	1.11	1.16	0.39	.234
15.00	-0.18	2.50	1.08	1.16	0.40	.238
15.20	-0.24	2.42	1.05	1.16	0.41	.242
15.40	-0.29	2.33	1.02	1.15	0.42	.245
15.60	-0.32	2.24	0.99	1.14	0.44	.247
15.80	-0.36	2.14	0.95	1.13	0.45	.249
16.00	-0.37	2.05	0.92	1.11	0.47	.250
16.20	-0.38	1.95	0.89	1.09	0.49	.250
16.40	-0.38	1.85	0.87	1.06	0.52	.249
16.60	-0.36	1.76	0.85	1.04	0.55	.246
16.80	-0.35	1.67	0.82	1.02	0.57	.244
17.00	-0.33	1.59	0.80	0.99	0.60	.240
17.20	-0.31	1.51	0.79	0.96	0.64	.236
17.40	-0.28	1.44	0.77	0.93	0.67	.230
17.60	-0.24	1.37	0.76	0.90	0.71	.224
17.80	-0.21	1.31	0.75	0.87	0.75	.217
18.00	-0.17	1.25	0.74	0.85	0.79	.209
18.20	-0.13	1.20	0.73	0.82	0.82	.201
18.40	-0.09	1.16	0.73	0.79	0.86	.192
18.60	-0.06	1.12	0.73	0.77	0.89	.185
18.80	-0.02	1.08	0.73	0.74	0.93	.177
19.00	0.01	1.04	0.72	0.72	0.96	.170
19.20	0.05	1.01	0.73	0.69	0.99	.161
19.40	0.07	0.99	0.73	0.68	1.01	.155
19.60	0.09	0.95	0.72	0.66	1.04	.150
19.80	0.12	0.92	0.72	0.64	1.07	.143
20.00	0.14	0.89	0.72	0.62	1.10	.137
20.20	0.16	0.86	0.72	0.60	1.12	.131
20.40	0.19	0.83	0.72	0.57	1.15	.125
20.60	0.20	0.79	0.71	0.55	1.19	.119
20.80	0.24	0.75	0.72	0.52	1.21	.110
21.00	0.28	0.72	0.72	0.50	1.21	.100
21.20	0.32	0.69	0.73	0.47	1.20	.091
21.40	0.35	0.67	0.74	0.45	1.17	.083
21.60	0.39	0.65	0.75	0.43	1.14	.075
21.80	0.42	0.63	0.77	0.41	1.10	.068
22.00	0.45	0.62	0.78	0.40	1.07	.063
22.20	0.48	0.60	0.79	0.38	1.02	.056
22.40	0.52	0.58	0.81	0.36	0.96	.050
22.60	0.55	0.57	0.82	0.35	0.91	.045
22.80	0.58	0.56	0.83	0.34	0.86	.041
23.00	0.61	0.56	0.85	0.33	0.82	.038
23.20	0.64	0.55	0.86	0.32	0.77	.034
23.40	0.66	0.54	0.87	0.31	0.74	.032
23.60	0.69	0.54	0.88	0.30	0.70	.029
23.80	0.72	0.54	0.90	0.30	0.67	.027
24.00	0.74	0.53	0.91	0.29	0.64	.025
24.20	0.76	0.53	0.92	0.29	0.62	.024
24.40	0.79	0.53	0.93	0.28	0.59	.023
24.60	0.81	0.53	0.94	0.28	0.57	.022
24.80	0.82	0.53	0.95	0.28	0.55	.021
25.00	0.85	0.52	0.96	0.27	0.53	.020
25.20	0.86	0.53	0.97	0.27	0.51	.019
25.40	0.89	0.52	0.99	0.27	0.50	.019

Nb

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\epsilon)$	$R(\phi=0)$
25.60	0.90	0.52	0.99	0.26	0.48	.018
25.80	0.92	0.52	0.99	0.25	0.47	.017
26.00	0.94	0.52	1.00	0.26	0.45	.017
26.20	0.95	0.52	1.01	0.26	0.44	.016
26.40	0.97	0.52	1.02	0.26	0.43	.016
26.60	0.99	0.52	1.03	0.25	0.42	.015
26.80	1.00	0.52	1.03	0.25	0.41	.016
27.00	1.02	0.52	1.04	0.25	0.40	.015
27.20	1.03	0.52	1.05	0.25	0.39	.015
27.40	1.05	0.53	1.05	0.25	0.38	.015
27.60	1.07	0.53	1.06	0.25	0.37	.015
27.80	1.09	0.52	1.07	0.25	0.36	.015
28.00	1.11	0.53	1.08	0.24	0.35	.015
28.20	1.13	0.53	1.09	0.24	0.34	.015
28.40	1.14	0.54	1.10	0.24	0.34	.015
28.60	1.16	0.54	1.11	0.24	0.33	.016
28.80	1.19	0.55	1.12	0.25	0.32	.016
29.00	1.21	0.55	1.13	0.25	0.31	.017
29.20	1.23	0.56	1.14	0.25	0.31	.017
29.40	1.25	0.58	1.15	0.25	0.30	.018
29.60	1.27	0.60	1.16	0.26	0.30	.020
29.80	1.29	0.62	1.17	0.27	0.30	.021
30.00	1.31	0.66	1.18	0.28	0.31	.023
30.20	1.31	0.68	1.18	0.29	0.31	.024
30.40	1.30	0.71	1.18	0.30	0.32	.026
30.60	1.29	0.73	1.18	0.31	0.33	.026
30.80	1.28	0.73	1.17	0.31	0.33	.026
31.00	1.29	0.73	1.18	0.31	0.33	.026
31.20	1.30	0.74	1.18	0.31	0.33	.027
31.40	1.32	0.75	1.19	0.32	0.33	.028
31.60	1.32	0.77	1.20	0.32	0.33	.029
31.80	1.33	0.79	1.20	0.33	0.33	.030
32.00	1.33	0.81	1.20	0.34	0.33	.031
32.20	1.33	0.83	1.21	0.35	0.34	.032
32.40	1.33	0.85	1.21	0.35	0.34	.034
32.60	1.33	0.87	1.21	0.36	0.34	.035
32.80	1.33	0.90	1.21	0.37	0.35	.036
33.00	1.32	0.92	1.21	0.38	0.35	.038
33.20	1.31	0.94	1.21	0.39	0.36	.039
33.40	1.30	0.96	1.21	0.40	0.37	.040
33.60	1.29	0.98	1.21	0.41	0.37	.041
33.80	1.28	1.00	1.21	0.41	0.38	.043
34.00	1.27	1.02	1.20	0.42	0.39	.044
34.40	1.23	1.05	1.20	0.44	0.40	.046
34.80	1.20	1.08	1.19	0.46	0.42	.049
35.20	1.15	1.11	1.17	0.47	0.43	.051
35.60	1.11	1.13	1.16	0.49	0.45	.053
36.00	1.06	1.15	1.15	0.50	0.47	.055
36.40	1.01	1.16	1.13	0.51	0.49	.058
36.80	0.95	1.15	1.11	0.52	0.52	.060
37.50	0.85	1.14	1.07	0.53	0.56	.064
38.50	0.73	1.06	1.00	0.53	0.64	.065
39.50	0.66	0.96	0.95	0.50	0.71	.063
40.50	0.62	0.86	0.92	0.47	0.77	.054

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Mo
				Film	X-tal	Bulk	Prep		
GSS77			773					ϵ	emissivity
ST77	0.05-0.1	Ellips			x		MP	$-\epsilon_1,\epsilon_2/\lambda$	
NC78	0.5-6.2	Trans, Refl	·	x			Ex	R	examined dependence of R on substrate temperature; x-ray diffraction and TEM
GCS79	0.32-5.6	Trans, Refl		x			In	σ	uhv evaporation in situ
Man80	1.5-38	Trans		x			Ex	$\mathrm{Im}(\epsilon^{-1})$; KK: ϵ_1,ϵ_2,R	energy loss spectroscopy
NC80	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	see also NC78
NCC80	0.5-6.5	Trans, Refl		x			Ex	σ	examined dependence of R on substrate temperature
CS79	0.08-0.41			x			Ex	R	chem-vapor deposited Mo

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Mo
				Film	X-tal	Bulk	Prep		
Sa39	2.6-27.6	Refl		x			Ex	R	
LFJ64	7.1-23.6	Refl				x	Heat	R	MP rolled samples, vacuum annealed
WJ64	2.14-5	m-θ				x	In	R,n,k	heated ∿1800 K in situ, uhv
KC65	0.05-5	Ellips				x	MP	$n,k,\sigma,\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$, R	
AU66	2.5-55	Refl	∿2000			x	Heat	$\mathrm{Im}(\varepsilon^{-1})$	energy loss spectroscopy at several temperatures
Ba66	0.6-2.6	Ellips				x	Heat	n,k	filaments at various T
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
KBM67	0.07-12	Refl, Ellips				x	MP	$A,n,k,\varepsilon_1,\sigma,\mathrm{Im}(\varepsilon^{-1})$; KK: $\varepsilon_1,\sigma,\mathrm{Im}(\varepsilon^{-1})$	
JLM68	2.1-23.1	m-θ				x	Heat	$R,n,k,\varepsilon_1,\varepsilon_2$	heated ∿2200 K in situ, ∿10^{-9} Torr
Le67	0.1-4	Ellips					MP	ε_2/λ	data from LT66 and LTA66
KUS69	1.4-11	Refl			x			R; KK: $\varepsilon_1,\varepsilon_2(h\nu)^2$, $\mathrm{Im}(\varepsilon^{-1})$	
CMB70			1900-2800					$\varepsilon_N,\varepsilon_H$	emissivity
KL70	0.5-14	Refl		x		x	In	R; KK: $\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$ $\mathrm{Im}(\varepsilon+1)^{-1}$	in situ film and EP bulk

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Mo
				Film	X-tal	Bulk	Prep		
Hu71	9.9-24.8	Refl		x			Ex	R	
KNN71	0.06-4.9	Ellips			x		EP	$R,n,k,\varepsilon_1,\varepsilon_2,\sigma$	see also KN78
UKK71	1-12	Refl			x		Heat	R; KK: $\varepsilon_1,\varepsilon_2(h\nu)^2$	heated ∿1700 K
Gr72	1.65-4	Trans, Refl		x			Ex	σ	
Vuj72			1000-2000					ε	emissivity
BK873			1000-2400					ε_N at λ = 6450 Å	emissivity
VP74	0.5-6	Refl			x		EP	R; KK: $\varepsilon_1,\varepsilon_2$	EP and sputtered in glow discharge of Ar in situ
WLO74	0.1-35	Refl	4.2 for $h\nu < 4.88$ eV RT for $h\nu > 4.88$ eV			x	EP	A,R; KK: $\varepsilon_1,\varepsilon_2$, $\mathrm{Im}(\varepsilon^{-1}),\mathrm{Im}(\varepsilon+1)^{-1}$	absorptivity measured by calorimetry for $h\nu < 5$ eV, reflectivity measured for $h\nu > 4$ eV with synchrotron radiation, see also WeO75
BLR76	∿0-50	Trans			x			$\mathrm{Im}(\varepsilon^{-1})$	energy loss spectroscopy
CGS76	0.32-5.5	Trans, Refl		x			In	σ	uhv evaporation in situ
WO76	20-250	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
BLO77	0.1-25	Refl	4.2 for $h\nu < 5$ eV 300 K for $h\nu > 5$ eV			x	EP	A,R; KK: σ	Nb, Mo of WLO74; Nb-Mo alloy study with synchrotron radiation

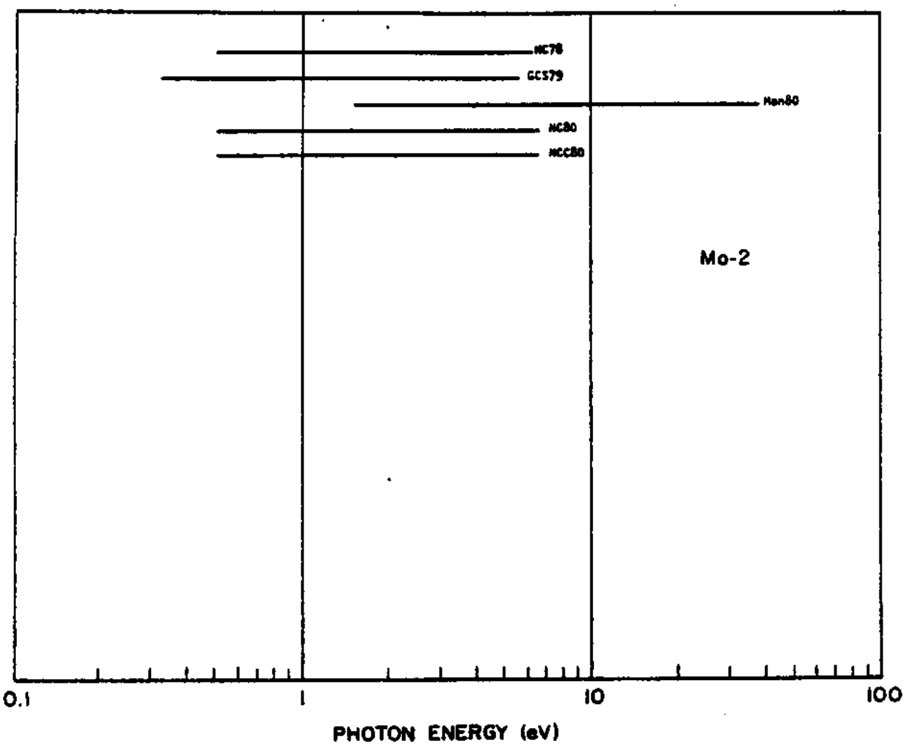

Fig. 48 Survey of available data for Mo

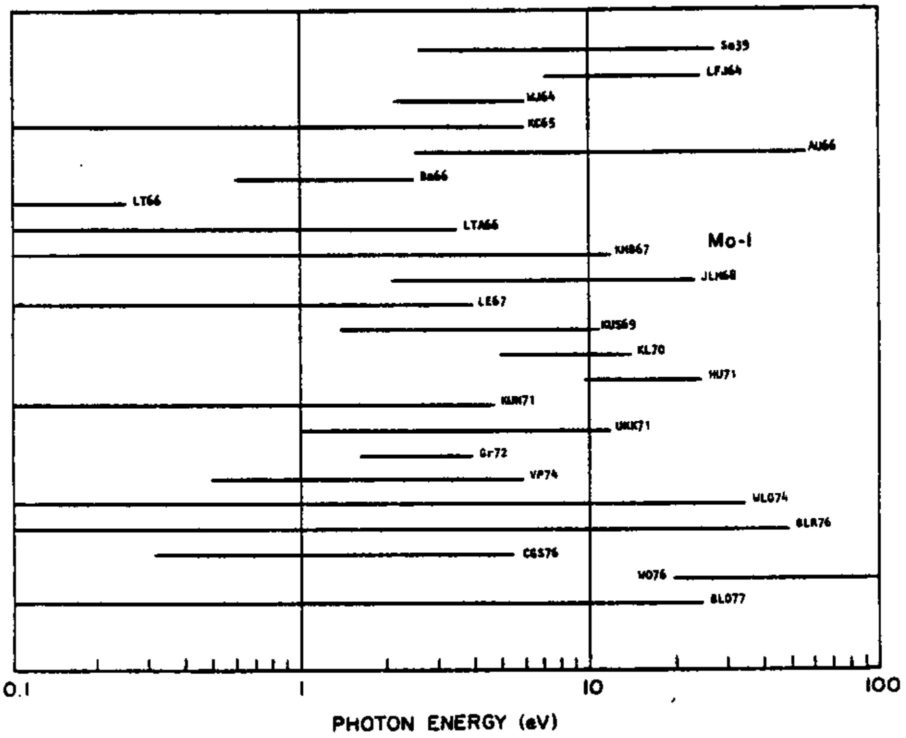

Fig. 48 Survey of available data for Mo

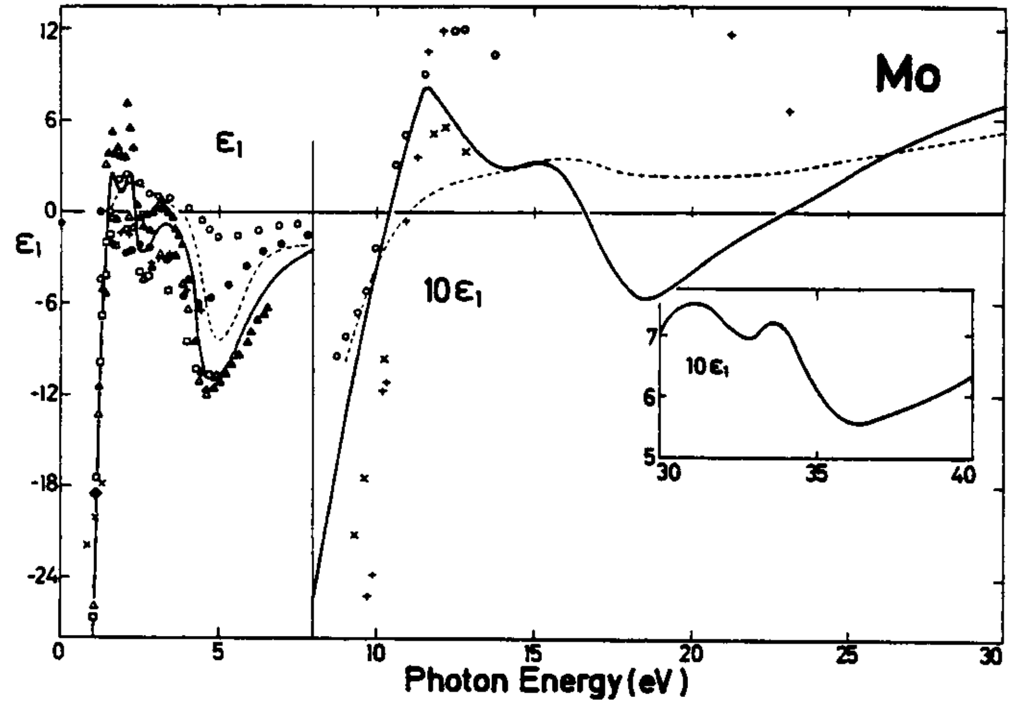

Fig. 50 ε_1 for Mo. —— WL075; +++ JLM68; ΔΔΔ VP74; ▲▲▲NC80; ●●● UKK71; ○○○ KL70; □□□ KNN71; ◆◆◆KC65; xxx KBM67; --- Man80.

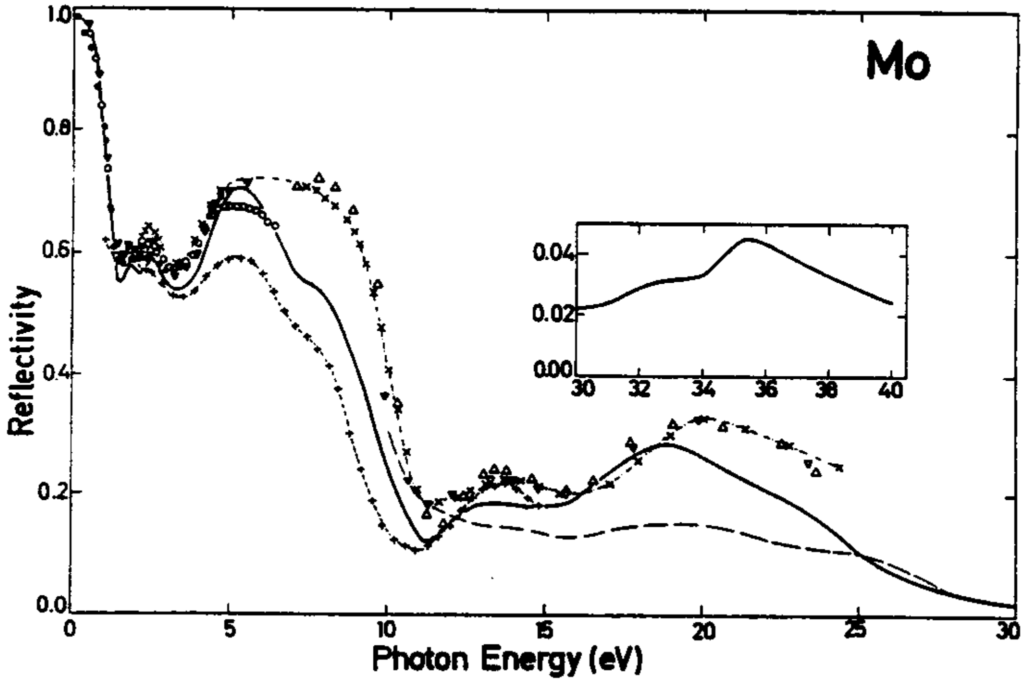

Fig. 49 Reflectivity for Mo. —— WL075; xxx JLM68; ●●● KNN71; +++ UKK71; ΔΔΔ LFJ64; ○○○ NC80; ∇∇∇ Hu71; ▼▼▼ VP74; — — Man80.

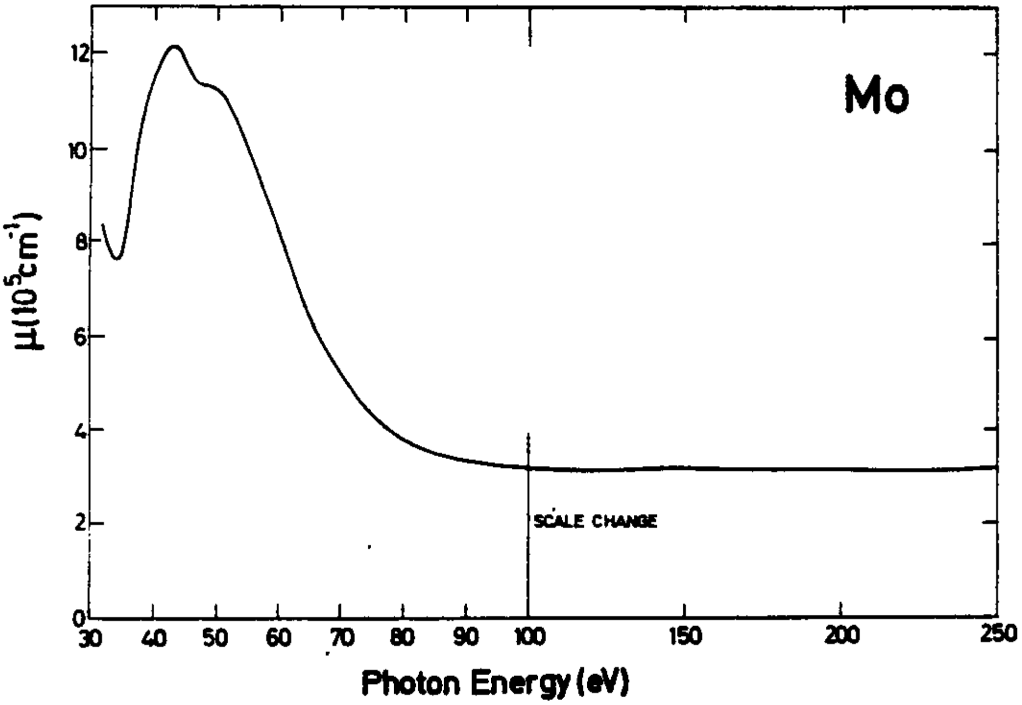

Fig. 52 Absorption coefficient for Mo reported by WO76.

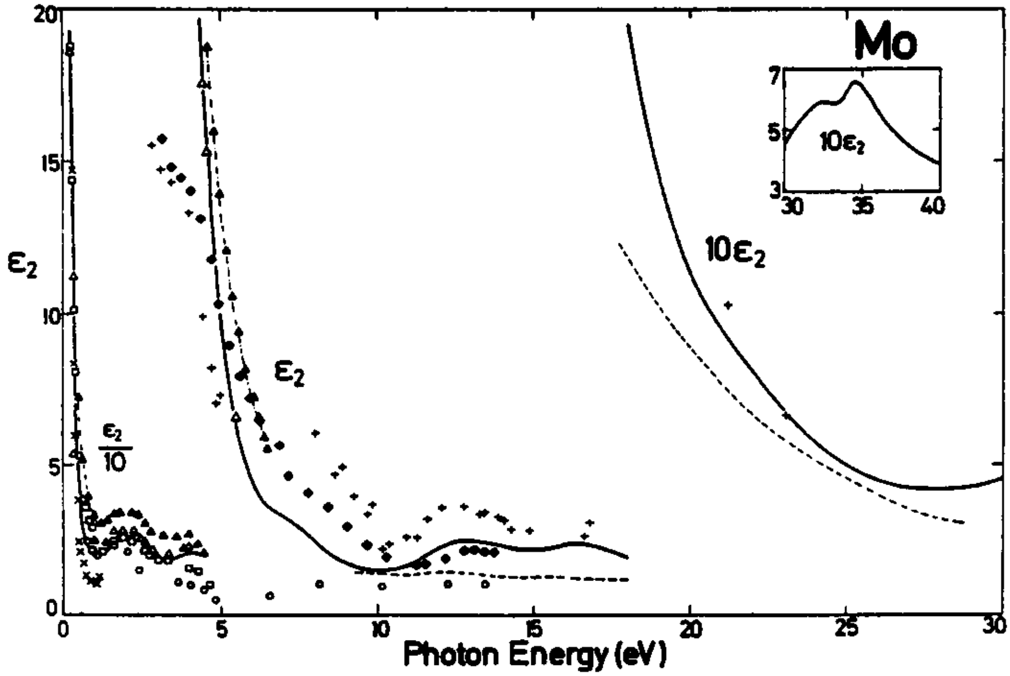

Fig. 51 ϵ_2 for Mo. —— WLO75; ◆◆◆ KL70; xxx KBM67; +++ JLN68; □□□ KNN71; ▲▲▲ NC80; ΔΔΔ VP74; ooo KC65; --- Man80.

Molybdenum

publication by J.H. Weaver, D.W. Lynch, and C.G. Olson in Phys. Rev. B <u>10</u>, 501 (1973) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
0.10	-4350.67	2538.73	18.53	68.51	0.00	.985
0.11	-3733.07	1972.43	15.64	63.07	0.00	.985
0.12	-3233.44	1565.27	13.40	58.42	0.00	.985
0.13	-2825.68	1243.51	11.44	54.37	0.00	.985
0.14	-2472.64	1010.43	9.96	50.71	0.00	.985
0.15	-2182.97	834.39	8.78	47.54	0.00	.985
0.16	-1940.24	691.92	7.74	44.72	0.00	.985
0.17	-1730.85	582.39	6.91	42.17	0.00	.985
0.18	-1553.25	495.19	6.21	39.90	0.00	.985
0.19	-1400.80	424.58	5.61	37.85	0.00	.985
0.20	-1268.94	366.75	5.10	35.99	0.00	.985
0.21	-1154.12	318.90	4.65	34.29	0.00	.985
0.22	-1053.49	278.94	4.26	32.74	0.00	.984
0.23	-964.76	245.28	3.92	31.31	0.00	.984
0.24	-885.78	216.57	3.61	29.98	0.00	.984
0.25	-815.34	193.33	3.36	28.75	0.00	.984
0.26	-753.33	173.57	3.14	27.63	0.00	.984
0.27	-697.80	155.40	2.92	26.58	0.00	.984
0.28	-647.23	140.34	2.74	25.59	0.00	.984
0.29	-601.63	127.15	2.58	24.66	0.00	.983
0.30	-560.32	116.27	2.44	23.80	0.00	.983
0.34	-430.24	83.13	2.00	20.84	0.00	.982
0.38	-337.29	62.82	1.70	18.44	0.00	.980
0.42	-269.84	51.78	1.57	16.50	0.00	.978
0.46	-220.21	43.42	1.46	14.91	0.00	.975
0.50	-181.59	37.14	1.37	13.55	0.00	.971
0.54	-151.03	33.29	1.35	12.36	0.00	.966
0.58	-126.76	30.40	1.34	11.34	0.00	.960
0.62	-107.13	28.74	1.38	10.44	0.00	.952
0.66	-91.40	27.61	1.43	9.67	0.00	.942
0.70	-78.64	26.59	1.48	8.99	0.00	.932
0.74	-67.90	25.40	1.51	8.38	0.00	.921
0.78	-58.72	25.03	1.60	7.83	0.01	.906
0.82	-51.33	24.10	1.64	7.35	0.01	.892
0.86	-44.66	23.45	1.70	6.89	0.01	.876
0.90	-38.90	22.59	1.74	6.48	0.01	.859
1.00	-27.41	21.69	1.94	5.58	0.02	.805
1.10	-18.87	20.90	2.15	4.85	0.03	.743
1.20	-11.89	20.63	2.44	4.22	0.04	.671
1.30	-6.34	20.74	2.77	3.74	0.04	.608
1.40	-1.60	21.42	3.15	3.40	0.05	.562
1.50	1.56	23.29	3.53	3.30	0.04	.550
1.60	2.57	25.71	3.77	3.41	0.04	.562
1.70	2.43	26.91	3.84	3.51	0.04	.570
1.80	1.72	27.27	3.81	3.58	0.04	.576
1.90	1.17	26.76	3.74	3.58	0.04	.576
2.00	1.17	25.95	3.68	3.52	0.04	.571
2.10	1.61	25.43	3.68	3.45	0.04	.565
2.20	2.49	25.65	3.76	3.41	0.04	.562
2.30	1.34	27.34	3.79	3.61	0.04	.578
2.40	-1.39	27.17	3.59	3.78	0.04	.594
2.50	-2.61	25.03	3.36	3.73	0.04	.591
2.60	-2.68	23.23	3.22	3.61	0.04	.582
2.70	-2.47	21.99	3.13	3.51	0.04	.573
2.80	-2.19	21.03	3.08	3.42	0.05	.565
2.90	-1.76	20.31	3.05	3.33	0.05	.556
3.00	-1.47	19.87	3.04	3.27	0.05	.550
3.10	-1.13	19.51	3.03	3.21	0.05	.544
3.20	-0.82	19.39	3.05	3.18	0.05	.540
3.30	-0.76	19.47	3.06	3.18	0.05	.540
3.40	-0.82	19.52	3.06	3.19	0.05	.541
3.50	-0.96	19.60	3.06	3.21	0.05	.543
3.60	-1.17	19.72	3.05	3.23	0.05	.546
3.70	-1.47	19.87	3.04	3.27	0.05	.550
3.80	-1.70	20.11	3.04	3.31	0.05	.554
3.90	-2.35	20.64	3.04	3.40	0.05	.564
4.00	-3.26	21.11	3.01	3.51	0.05	.576
4.10	-4.97	21.36	2.91	3.67	0.04	.595
4.20	-6.52	20.88	2.77	3.77	0.04	.610
4.30	-8.22	19.96	2.59	3.86	0.04	.627
4.40	-9.35	18.55	2.39	3.88	0.04	.640
4.50	-10.07	17.10	2.21	3.87	0.04	.650
4.60	-10.48	15.77	2.06	3.84	0.04	.658
4.70	-10.87	14.48	1.90	3.81	0.04	.668
4.80	-11.07	13.14	1.75	3.76	0.04	.678
4.90	-11.08	11.86	1.61	3.70	0.05	.686
5.00	-10.98	10.61	1.46	3.62	0.05	.695
5.10	-10.69	9.40	1.33	3.53	0.05	.702
5.20	-10.20	8.36	1.22	3.42	0.05	.706
5.30	-9.66	7.50	1.13	3.31	0.05	.707
5.40	-9.09	6.81	1.07	3.20	0.05	.706
5.50	-8.56	6.22	1.01	3.09	0.06	.704
5.60	-8.02	5.73	0.96	2.99	0.05	.700
5.70	-7.52	5.34	0.92	2.89	0.06	.694
5.80	-7.06	5.02	0.89	2.80	0.07	.688
5.90	-6.64	4.75	0.87	2.72	0.07	.680
6.00	-6.27	4.50	0.85	2.64	0.08	.674
6.10	-5.91	4.30	0.84	2.57	0.08	.665
6.20	-5.61	4.07	0.81	2.50	0.08	.660
6.30	-5.28	3.88	0.80	2.43	0.09	.651
6.40	-4.96	3.73	0.79	2.36	0.10	.641
6.50	-4.67	3.60	0.78	2.30	0.10	.630
6.60	-4.41	3.49	0.79	2.24	0.11	.619
6.70	-4.15	3.39	0.78	2.18	0.12	.607
6.80	-3.90	3.33	0.78	2.13	0.13	.592
6.90	-3.70	3.29	0.79	2.08	0.13	.580
7.00	-3.52	3.25	0.80	2.04	0.14	.568
7.10	-3.36	3.24	0.81	2.00	0.15	.556
7.20	-3.25	3.22	0.81	1.98	0.15	.548
7.30	-3.16	3.19	0.82	1.96	0.16	.542
7.40	-3.13	3.14	0.81	1.95	0.16	.542
7.50	-3.12	3.02	0.78	1.93	0.16	.547
7.60	-3.06	2.83	0.75	1.90	0.15	.552
7.70	-2.91	2.69	0.73	1.85	0.17	.547
7.80	-2.78	2.58	0.71	1.81	0.19	.542
7.90	-2.65	2.47	0.70	1.77	0.19	.537

Mo

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(ϕ=0)
8.00	-2.52	2.37	0.69	1.73	0.20	.530
8.20	-2.27	2.21	0.67	1.65	0.22	.512
8.40	-2.03	2.07	0.66	1.57	0.25	.495
8.60	-1.80	1.94	0.65	1.49	0.28	.475
8.80	-1.57	1.82	0.65	1.41	0.31	.450
9.00	-1.34	1.74	0.65	1.33	0.36	.420
9.20	-1.12	1.68	0.67	1.25	0.41	.395
9.40	-0.94	1.63	0.69	1.19	0.46	.355
9.60	-0.75	1.58	0.71	1.12	0.52	.320
9.80	-0.56	1.54	0.74	1.05	0.57	.285
10.00	-0.38	1.52	0.77	0.99	0.62	.250
10.20	-0.20	1.51	0.81	0.93	0.65	.217
10.40	-0.04	1.51	0.86	0.88	0.66	.188
10.60	0.13	1.52	0.91	0.83	0.65	.162
10.80	0.33	1.54	0.98	0.79	0.62	.138
11.00	0.51	1.63	1.05	0.77	0.56	.125
11.20	0.65	1.75	1.12	0.78	0.50	.123
11.40	0.76	1.90	1.18	0.80	0.45	.125
11.60	0.79	2.08	1.23	0.85	0.42	.135
11.80	0.77	2.21	1.25	0.89	0.40	.145
12.00	0.73	2.32	1.26	0.92	0.39	.154
12.20	0.67	2.39	1.26	0.95	0.39	.162
12.40	0.61	2.43	1.25	0.98	0.39	.168
12.60	0.55	2.46	1.24	0.99	0.39	.174
12.80	0.50	2.47	1.23	1.00	0.39	.178
13.00	0.43	2.47	1.21	1.02	0.39	.182
13.20	0.38	2.45	1.20	1.02	0.40	.185
13.40	0.34	2.42	1.18	1.02	0.41	.186
13.60	0.31	2.39	1.17	1.02	0.41	.187
13.90	0.30	2.35	1.15	1.02	0.42	.186
14.00	0.29	2.32	1.15	1.01	0.42	.185
14.20	0.28	2.29	1.14	1.00	0.43	.184
14.40	0.29	2.26	1.13	1.00	0.44	.182
14.60	0.31	2.24	1.13	0.99	0.44	.180
14.80	0.31	2.24	1.13	0.99	0.44	.179
15.00	0.32	2.25	1.14	0.99	0.44	.179
15.20	0.32	2.26	1.14	0.99	0.43	.179
15.40	0.32	2.28	1.15	0.99	0.43	.180
15.60	0.31	2.31	1.15	1.01	0.43	.184
15.80	0.27	2.34	1.15	1.02	0.42	.188
16.00	0.22	2.37	1.14	1.04	0.42	.194
16.20	0.17	2.39	1.13	1.05	0.42	.200
16.40	0.09	2.40	1.12	1.08	0.42	.207
16.60	0.00	2.40	1.10	1.10	0.42	.216
16.90	-0.09	2.38	1.07	1.11	0.42	.225
17.00	-0.18	2.34	1.04	1.12	0.43	.233
17.20	-0.26	2.28	1.01	1.13	0.43	.241
17.40	-0.33	2.22	0.98	1.13	0.44	.248
17.60	-0.42	2.14	0.94	1.14	0.45	.257
17.80	-0.47	2.05	0.90	1.13	0.46	.264
18.00	-0.51	1.95	0.87	1.12	0.48	.270
18.20	-0.54	1.85	0.83	1.11	0.50	.275
18.40	-0.55	1.75	0.80	1.10	0.52	.280
18.60	-0.57	1.65	0.77	1.08	0.54	.283
18.80	-0.56	1.55	0.74	1.05	0.57	.285
19.00	-0.54	1.46	0.71	1.02	0.60	.284
19.20	-0.51	1.38	0.69	1.00	0.64	.282

Mo

Energy (eV)	ε_1	ε_2	n	k	Im(-1/$\tilde{\varepsilon}$)	R(ϕ=0)
19.40	-0.48	1.30	0.67	0.97	0.67	.279
19.60	-0.45	1.24	0.66	0.94	0.71	.275
19.80	-0.41	1.18	0.65	0.91	0.75	.270
20.00	-0.38	1.13	0.64	0.89	0.79	.264
20.20	-0.34	1.09	0.63	0.86	0.83	.258
20.40	-0.31	1.05	0.63	0.84	0.88	.252
20.60	-0.28	1.01	0.62	0.81	0.92	.245
20.80	-0.25	0.98	0.62	0.79	0.96	.240
21.00	-0.22	0.95	0.61	0.77	1.00	.234
21.20	-0.19	0.92	0.61	0.75	1.04	.227
21.40	-0.17	0.89	0.61	0.73	1.08	.221
21.60	-0.14	0.87	0.61	0.71	1.12	.215
21.80	-0.12	0.85	0.61	0.70	1.15	.210
22.00	-0.11	0.82	0.60	0.69	1.19	.207
22.20	-0.09	0.80	0.60	0.67	1.24	.203
22.40	-0.07	0.77	0.59	0.65	1.29	.198
22.60	-0.05	0.75	0.59	0.63	1.33	.195
22.80	-0.03	0.72	0.58	0.61	1.39	.190
23.00	-0.01	0.69	0.58	0.60	1.44	.185
23.20	0.00	0.67	0.58	0.57	1.50	.180
23.40	0.03	0.64	0.58	0.55	1.56	.173
23.60	0.05	0.62	0.58	0.53	1.61	.166
23.80	0.08	0.59	0.58	0.51	1.66	.158
24.00	0.10	0.57	0.58	0.49	1.70	.151
24.20	0.13	0.55	0.59	0.47	1.72	.142
24.40	0.16	0.53	0.60	0.45	1.73	.132
24.60	0.18	0.52	0.60	0.43	1.73	.124
24.80	0.21	0.50	0.61	0.41	1.70	.115
25.00	0.23	0.49	0.62	0.39	1.66	.106
25.20	0.26	0.48	0.64	0.38	1.60	.098
25.40	0.28	0.47	0.64	0.37	1.56	.092
25.60	0.31	0.46	0.66	0.35	1.51	.085
25.80	0.33	0.45	0.67	0.34	1.45	.079
26.00	0.35	0.45	0.68	0.33	1.37	.072
26.25	0.38	0.44	0.69	0.32	1.30	.066
26.50	0.40	0.44	0.71	0.31	1.24	.060
26.75	0.43	0.43	0.72	0.30	1.16	.055
27.00	0.46	0.42	0.73	0.29	1.10	.050
27.25	0.48	0.42	0.75	0.28	1.03	.045
27.50	0.51	0.42	0.76	0.28	0.97	.041
27.75	0.53	0.42	0.78	0.27	0.92	.038
28.00	0.55	0.42	0.79	0.27	0.88	.036
28.25	0.57	0.42	0.80	0.26	0.84	.034
28.50	0.59	0.43	0.81	0.26	0.81	.031
28.75	0.61	0.43	0.82	0.26	0.78	.030
29.00	0.63	0.43	0.83	0.26	0.75	.028
29.25	0.65	0.43	0.84	0.26	0.71	.026
29.50	0.67	0.44	0.86	0.26	0.69	.025
29.75	0.69	0.44	0.87	0.26	0.66	.023
30.00	0.71	0.46	0.88	0.26	0.65	.023
30.25	0.73	0.47	0.89	0.26	0.63	.023
30.50	0.74	0.49	0.90	0.27	0.62	.023
30.75	0.75	0.51	0.91	0.28	0.62	.023
31.00	0.75	0.53	0.92	0.29	0.62	.024
31.25	0.75	0.55	0.92	0.30	0.63	.025
31.50	0.75	0.56	0.92	0.31	0.64	.027
31.75	0.74	0.58	0.92	0.31	0.65	.029

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(φ=0)
32.00	0.73	0.59	0.92	0.32	0.67	.030
32.20	0.73	0.60	0.91	0.33	0.68	.031
32.40	0.71	0.60	0.91	0.33	0.69	.032
32.60	0.70	0.60	0.90	0.33	0.70	.032
32.80	0.70	0.59	0.90	0.33	0.71	.032
33.00	0.70	0.59	0.90	0.33	0.71	.032
33.20	0.70	0.58	0.90	0.32	0.70	.031
33.40	0.71	0.58	0.90	0.32	0.69	.030
33.50	0.72	0.58	0.91	0.32	0.68	.030
33.60	0.72	0.59	0.91	0.33	0.68	.031
33.80	0.72	0.61	0.91	0.33	0.68	.032
34.00	0.71	0.63	0.91	0.34	0.70	.034
34.20	0.70	0.64	0.91	0.35	0.71	.035
34.40	0.68	0.65	0.90	0.36	0.73	.037
34.60	0.66	0.66	0.89	0.37	0.76	.040
34.80	0.64	0.66	0.88	0.37	0.79	.042
35.00	0.61	0.65	0.87	0.37	0.82	.043
35.20	0.59	0.64	0.85	0.37	0.85	.045
35.40	0.57	0.62	0.84	0.37	0.87	.045
35.60	0.56	0.60	0.83	0.36	0.89	.045
35.80	0.56	0.58	0.82	0.35	0.90	.044
36.00	0.56	0.56	0.82	0.34	0.90	.043
36.25	0.56	0.54	0.81	0.33	0.90	.042
36.50	0.56	0.52	0.81	0.32	0.90	.041
36.75	0.56	0.51	0.81	0.31	0.89	.040
37.00	0.56	0.49	0.81	0.30	0.88	.038
37.25	0.57	0.48	0.81	0.30	0.87	.037
37.50	0.57	0.47	0.81	0.29	0.86	.036
37.75	0.57	0.45	0.81	0.28	0.85	.034
38.00	0.58	0.44	0.81	0.27	0.83	.033
38.50	0.59	0.43	0.81	0.26	0.80	.031
39.00	0.61	0.41	0.82	0.25	0.77	.029
39.50	0.62	0.40	0.82	0.24	0.73	.026
40.00	0.63	0.39	0.83	0.23	0.71	.025

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Ru
KrL70	0.5-12	Refl		x			In	R	uhv evaporation in situ
CHR74	6.2-41.3	m-θ		x			Ex	R,n,k,ε_1,ε_2	included substrate temperature variation
CM76	1.97-2.84	Ellips			x		Heat	R,n,k	also LEED, AES; heat 1800°C uhv
KNN78	0.08-4.66	Ellips			x		EP	N,K,ε_1,ε_2,σ	table λ,n,k
WOL Unpl	0.1-60	Refl	4.2 for hν < 4.4 eV RT for hν > 4.4 eV		x		EP	R; KK: n,k,ε_1,ε_2	absorptivity measured by calorimetry hν < 4.4 eV, reflectivity measured hν > 4.4 eV, E⊥c, E∥c

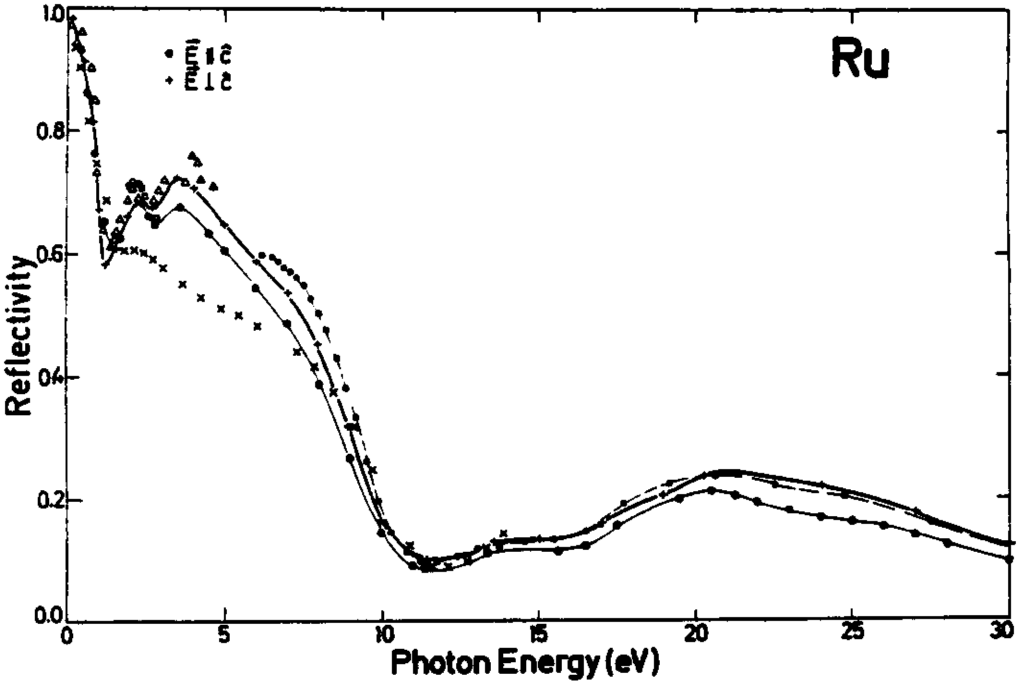

Fig. 54 Reflectivity of Ru. LOW (unpub) report results for single crystals with $\vec{E} \parallel \hat{c}$ (●●●) and $\vec{E} \perp \hat{c}$ (+++). Polycrystalline results as follows: ooo CHR74; xxx KL70; ΔΔΔ KNN78; □□□CM76.

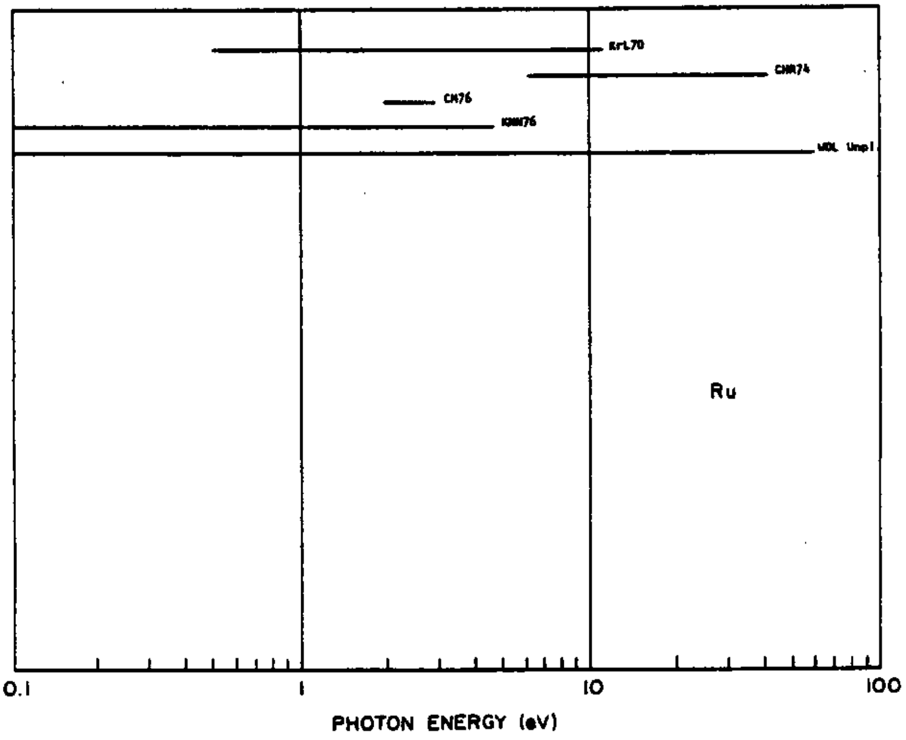

Fig. 53 Survey of available data for Ru

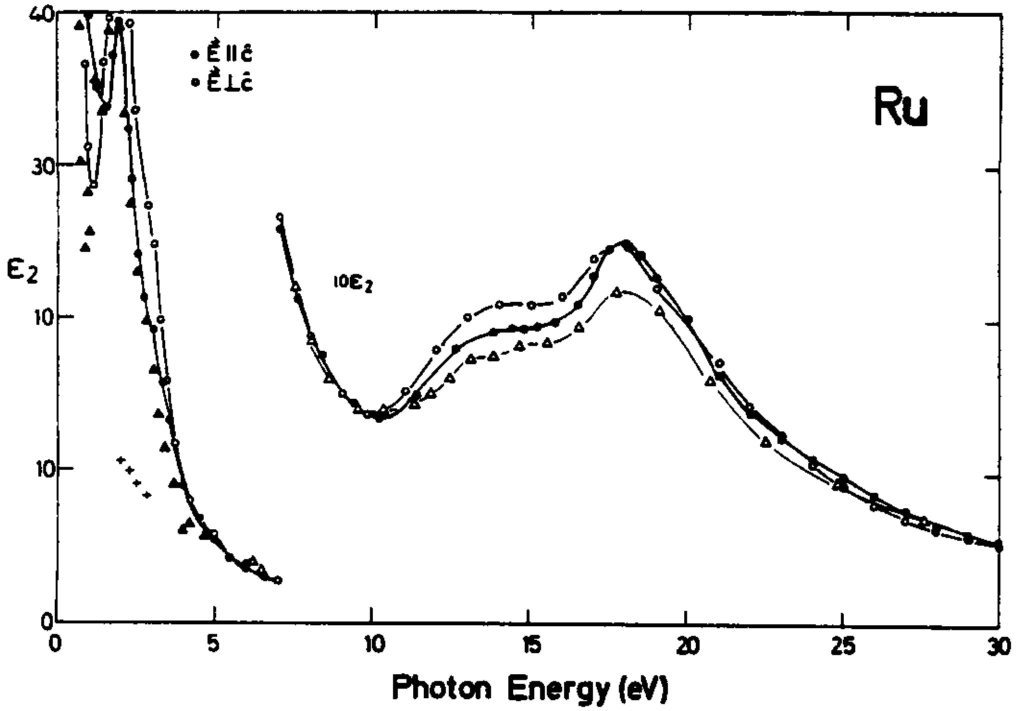

Fig. 56 ε_2 for Ru. LOW (unpub) report results for single crystals with $\vec{E} \parallel \hat{c}$ (●●●) and $\vec{E} \perp \hat{c}$ (○○○). Polycrystalline results as follows: ▲▲▲ KNN78; +++ CM76; ΔΔΔ CHR74.

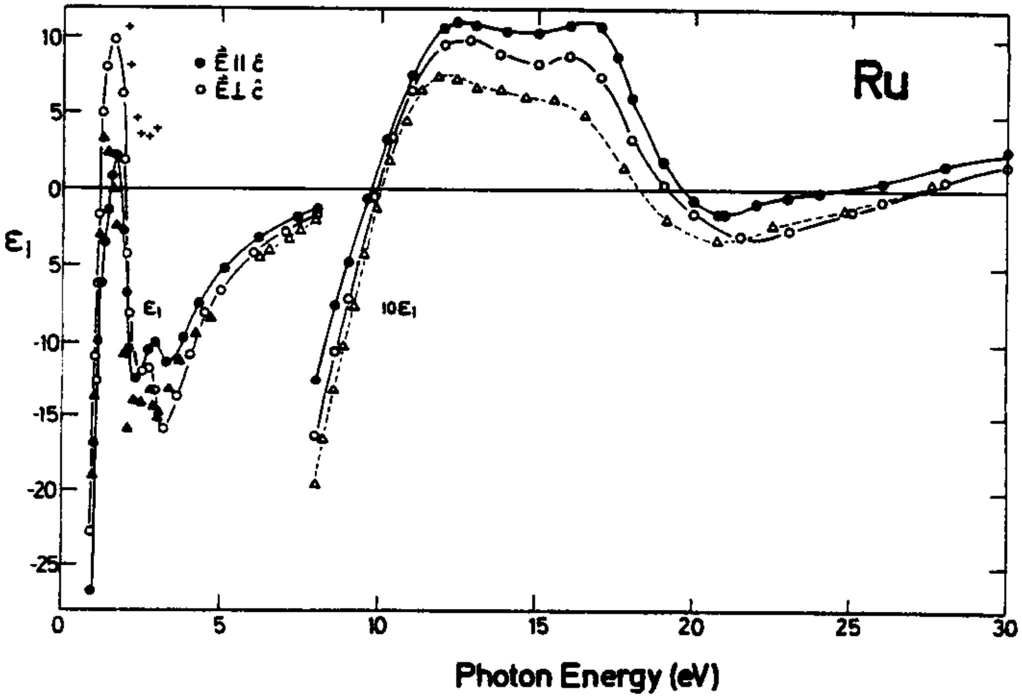

Fig. 55 ε_1 for Ru. LOW (unpub) report results for single crystals with $\vec{E} \parallel \hat{c}$ (●●●) and $\vec{E} \perp \hat{c}$ (○○○). Polycrystalline results as follows: ▲▲▲ KNN78; +++ CM76; ΔΔΔ CHR74.

Ruthenium single crystal with $\vec{E} \parallel \hat{a}$

D.W. Lynch, C.G. Olson, and J.H. Weaver (unpub)

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-2508.09	1181.78	11.50	51.38	0.00	.984
0.15	-1197.06	537.39	7.59	35.42	0.00	.977
0.20	-701.41	322.17	5.93	27.14	0.00	.970
0.25	-461.75	215.31	4.89	22.04	0.00	.962
0.30	-323.68	160.20	4.33	18.50	0.00	.953
0.35	-239.55	124.09	3.89	15.96	0.00	.944
0.40	-182.29	100.48	3.60	13.97	0.00	.933
0.45	-142.11	83.55	3.37	12.39	0.00	.922
0.50	-111.82	70.34	3.18	11.04	0.00	.909
0.55	-87.11	62.38	3.16	9.85	0.01	.889
0.60	-68.18	58.31	3.28	8.89	0.01	.865
0.65	-54.35	57.19	3.50	8.16	0.01	.839
0.70	-46.67	55.93	3.62	7.73	0.01	.822
0.75	-42.20	52.61	3.55	7.40	0.01	.812
0.80	-37.58	47.94	3.42	7.02	0.01	.801
0.85	-32.34	43.46	3.30	6.58	0.01	.786
0.90	-26.90	39.81	3.25	6.12	0.02	.766
0.95	-21.30	37.51	3.30	5.68	0.02	.740
1.00	-16.86	36.13	3.39	5.33	0.02	.715
1.05	-12.72	35.44	3.53	5.02	0.02	.691
1.10	-9.93	35.33	3.66	4.83	0.03	.675
1.15	-7.63	35.22	3.77	4.67	0.03	.662
1.20	-6.18	35.15	3.84	4.57	0.03	.654
1.25	-4.78	34.77	3.89	4.47	0.03	.645
1.30	-3.62	34.47	3.94	4.38	0.03	.638
1.35	-2.61	34.09	3.97	4.29	0.03	.632
1.40	-1.39	33.71	4.02	4.19	0.03	.624
1.45	-0.26	33.67	4.09	4.12	0.03	.618
1.50	0.80	33.85	4.16	4.07	0.03	.614
1.55	1.73	34.39	4.25	4.04	0.03	.613
1.60	2.12	35.31	4.33	4.08	0.03	.615
1.65	2.19	36.19	4.39	4.13	0.03	.619
1.70	1.80	37.17	4.42	4.21	0.03	.624
1.80	0.18	39.59	4.40	4.38	0.03	.636
1.90	-2.81	39.51	4.29	4.61	0.03	.651
2.00	-6.77	38.86	4.04	4.81	0.02	.667
2.10	-10.45	36.15	3.69	4.90	0.03	.679
2.15	-11.43	34.16	3.51	4.87	0.03	.682
2.20	-12.06	32.32	3.35	4.82	0.03	.683
2.25	-12.33	30.61	3.21	4.76	0.03	.682
2.30	-12.52	29.05	3.09	4.70	0.03	.681
2.35	-12.46	27.58	2.98	4.62	0.03	.679
2.40	-12.29	26.29	2.89	4.55	0.03	.677
2.50	-11.80	24.13	2.74	4.40	0.03	.671
2.60	-11.09	22.49	2.64	4.25	0.04	.663
2.70	-10.50	21.32	2.58	4.14	0.04	.656
2.80	-10.02	20.57	2.54	4.05	0.04	.650
2.90	-10.09	20.03	2.48	4.03	0.04	.650
3.00	-10.56	19.22	2.38	4.03	0.04	.656

Ru $\vec{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
3.10	-10.91	18.13	2.26	4.00	0.04	.661
3.20	-11.16	16.93	2.13	3.96	0.04	.666
3.30	-11.29	15.61	2.00	3.91	0.04	.671
3.40	-11.13	14.33	1.87	3.83	0.04	.673
3.50	-10.87	13.18	1.76	3.74	0.05	.674
3.60	-10.57	12.09	1.66	3.65	0.05	.675
3.70	-10.12	11.14	1.57	3.55	0.05	.673
3.80	-9.72	10.26	1.49	3.45	0.05	.672
3.90	-9.20	9.48	1.42	3.35	0.05	.668
4.00	-8.65	8.89	1.37	3.24	0.06	.561
4.10	-8.20	8.40	1.33	3.16	0.06	.655
4.20	-7.81	7.94	1.29	3.08	0.06	.649
4.30	-7.42	7.54	1.26	3.00	0.07	.643
4.40	-7.11	7.14	1.22	2.93	0.07	.639
4.50	-6.76	6.80	1.19	2.86	0.07	.633
4.60	-6.46	6.47	1.16	2.79	0.08	.628
4.70	-6.16	6.19	1.13	2.73	0.08	.622
4.80	-5.90	5.92	1.11	2.67	0.08	.617
4.90	-5.66	5.67	1.08	2.61	0.09	.612
5.00	-5.43	5.44	1.06	2.56	0.09	.607
5.10	-5.24	5.20	1.03	2.51	0.10	.604
5.20	-5.03	4.97	1.01	2.46	0.10	.600
5.30	-4.84	4.73	0.98	2.41	0.10	.597
5.40	-4.63	4.48	0.95	2.35	0.11	.593
5.50	-4.39	4.27	0.93	2.29	0.11	.586
5.60	-4.15	4.11	0.92	2.23	0.12	.576
5.70	-3.94	3.98	0.91	2.18	0.13	.567
5.80	-3.76	3.86	0.90	2.14	0.13	.559
5.90	-3.59	3.74	0.89	2.10	0.14	.552
6.00	-3.44	3.62	0.88	2.05	0.15	.545
6.20	-3.15	3.42	0.87	1.98	0.16	.531
6.40	-2.93	3.21	0.84	1.91	0.17	.521
6.60	-2.70	3.00	0.82	1.84	0.18	.510
6.80	-2.49	2.80	0.79	1.77	0.20	.500
7.00	-2.29	2.59	0.76	1.69	0.22	.489
7.20	-2.05	2.41	0.75	1.61	0.24	.472
7.40	-1.84	2.25	0.73	1.54	0.27	.455
7.60	-1.61	2.12	0.73	1.46	0.30	.433
7.80	-1.42	2.02	0.73	1.39	0.33	.411
8.00	-1.25	1.92	0.72	1.33	0.37	.391
8.20	-1.07	1.83	0.72	1.26	0.41	.366
8.40	-0.91	1.75	0.73	1.20	0.45	.342
8.60	-0.76	1.68	0.74	1.14	0.49	.314
8.80	-0.63	1.60	0.74	1.08	0.54	.295
9.00	-0.47	1.54	0.75	1.02	0.59	.267
9.20	-0.34	1.49	0.77	0.97	0.64	.243
9.40	-0.21	1.44	0.79	0.91	0.68	.217
9.60	-0.07	1.40	0.82	0.86	0.71	.190
9.80	0.06	1.36	0.85	0.81	0.73	.167
10.00	0.20	1.34	0.88	0.76	0.73	.144
10.20	0.33	1.33	0.92	0.72	0.71	.125
10.40	0.45	1.33	0.96	0.69	0.67	.110
10.60	0.57	1.35	1.01	0.67	0.63	.102
10.80	0.67	1.39	1.05	0.66	0.59	.094
11.00	0.76	1.42	1.09	0.65	0.55	.090
11.20	0.84	1.45	1.12	0.65	0.52	.088
11.40	0.91	1.49	1.15	0.65	0.49	.087

Ru $\vec{E}\parallel\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
11.60	0.97	1.54	1.18	0.65	0.46	.088
11.80	1.03	1.59	1.21	0.66	0.44	.090
12.00	1.07	1.65	1.23	0.67	0.43	.092
12.20	1.09	1.70	1.25	0.68	0.42	.095
12.40	1.11	1.75	1.26	0.69	0.41	.098
12.60	1.11	1.80	1.27	0.71	0.40	.102
12.80	1.10	1.83	1.27	0.72	0.40	.104
13.00	1.10	1.86	1.28	0.73	0.40	.106
13.20	1.09	1.88	1.28	0.74	0.40	.108
13.40	1.08	1.90	1.28	0.75	0.40	.110
13.60	1.07	1.91	1.29	0.75	0.40	.111
13.80	1.07	1.91	1.28	0.75	0.40	.111
14.00	1.05	1.95	1.28	0.76	0.40	.114
14.20	1.04	1.94	1.27	0.76	0.40	.114
14.40	1.04	1.94	1.27	0.76	0.40	.114
14.60	1.04	1.94	1.27	0.76	0.40	.114
14.80	1.04	1.94	1.27	0.76	0.40	.114
15.00	1.04	1.94	1.27	0.76	0.40	.114
15.20	1.05	1.95	1.28	0.76	0.40	.114
15.40	1.05	1.96	1.28	0.77	0.40	.115
15.60	1.06	1.97	1.29	0.77	0.39	.115
15.80	1.09	1.98	1.29	0.76	0.39	.115
16.00	1.09	2.03	1.30	0.78	0.38	.118
16.25	1.10	2.06	1.31	0.79	0.38	.120
16.50	1.11	2.11	1.32	0.80	0.37	.123
16.75	1.11	2.18	1.33	0.82	0.36	.128
17.00	1.08	2.29	1.34	0.85	0.36	.136
17.25	1.00	2.39	1.34	0.89	0.36	.145
17.50	0.88	2.46	1.32	0.93	0.36	.155
17.75	0.75	2.50	1.30	0.96	0.37	.164
18.00	0.61	2.51	1.26	0.99	0.39	.173
18.25	0.47	2.48	1.22	1.01	0.39	.181
18.50	0.36	2.42	1.18	1.02	0.40	.185
18.75	0.25	2.35	1.14	1.03	0.42	.190
19.00	0.19	2.27	1.11	1.02	0.44	.192
19.25	0.13	2.21	1.08	1.02	0.45	.195
19.50	0.08	2.15	1.05	1.02	0.46	.199
19.75	0.00	2.08	1.02	1.02	0.48	.203
20.00	-0.06	2.01	0.99	1.02	0.50	.208
20.25	-0.11	1.91	0.95	1.01	0.52	.211
20.50	-0.14	1.82	0.92	0.99	0.55	.212
20.75	-0.15	1.72	0.89	0.97	0.58	.211
21.00	-0.15	1.63	0.86	0.94	0.61	.209
21.25	-0.13	1.56	0.85	0.92	0.64	.205
21.50	-0.13	1.49	0.83	0.90	0.67	.203
21.75	-0.11	1.43	0.61	0.88	0.70	.198
22.00	-0.08	1.36	0.81	0.86	0.72	.193
22.50	-0.06	1.30	0.79	0.82	0.77	.187
23.00	-0.04	1.22	0.77	0.79	0.62	.182
23.50	-0.01	1.15	0.75	0.76	0.87	.175
24.00	0.00	1.09	0.74	0.74	0.92	.171
24.50	0.03	1.03	0.73	0.71	0.97	.166
25.00	0.04	0.98	0.71	0.69	1.02	.163
25.50	0.04	0.92	0.69	0.66	1.08	.161
26.00	0.07	0.86	0.68	0.63	1.15	.154
26.50	0.09	0.61	0.67	0.60	1.23	.145
27.00	0.12	0.76	0.67	0.57	1.29	.140

Ru $\vec{E}\parallel\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
27.50	0.15	0.71	0.66	0.54	1.34	.132
28.00	0.18	0.67	0.66	0.51	1.39	.124
28.50	0.21	0.64	0.67	0.48	1.41	.115
29.00	0.24	0.62	0.67	0.46	1.42	.107
29.50	0.26	0.59	0.67	0.44	1.41	.101
30.00	0.27	0.57	0.67	0.43	1.43	.097
30.50	0.29	0.54	0.67	0.40	1.46	.093
31.00	0.31	0.50	0.67	0.37	1.43	.084
31.50	0.34	0.48	0.68	0.35	1.39	.077
32.00	0.37	0.46	0.69	0.33	1.34	.070
32.50	0.39	0.44	0.70	0.31	1.28	.064
33.00	0.41	0.43	0.71	0.30	1.21	.058
33.50	0.44	0.41	0.72	0.29	1.15	.053
34.00	0.46	0.40	0.73	0.27	1.08	.048
34.50	0.47	0.39	0.74	0.26	1.03	.045
35.00	0.51	0.38	0.75	0.25	0.94	.039
36.00	0.54	0.37	0.77	0.24	0.88	.035
37.00	0.57	0.36	0.79	0.23	0.80	.030
38.00	0.59	0.36	0.80	0.22	0.75	.027
39.00	0.62	0.35	0.82	0.22	0.70	.024
40.00	0.64	0.36	0.83	0.22	0.66	.022

Ruthenium single crystal with $\hat{E}\perp\hat{c}$

D.W. Lynch, C.G. Olson, and J.H. Weaver (unpub)

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-2440.73	1204.06	11.85	50.81	0.00	.983
0.15	-1163.96	589.65	8.39	35.13	0.00	.975
0.20	-694.01	363.06	6.68	27.18	0.00	.966
0.25	-464.30	249.97	5.61	22.27	0.00	.959
0.30	-333.67	186.97	4.94	18.92	0.00	.950
0.35	-253.16	141.56	4.30	16.48	0.00	.943
0.40	-195.40	113.11	3.90	14.51	0.00	.933
0.45	-155.44	91.74	3.54	12.96	0.00	.925
0.50	-124.65	76.13	3.27	11.63	0.00	.915
0.55	-100.73	64.94	3.09	10.50	0.00	.903
0.60	-82.08	56.78	2.98	9.54	0.01	.888
0.65	-67.50	50.47	2.90	8.71	0.01	.873
0.70	-55.87	45.10	2.82	7.99	0.01	.856
0.75	-46.03	40.59	2.77	7.33	0.01	.837
0.80	-37.59	36.73	2.73	6.71	0.01	.815
0.85	-30.00	33.44	2.73	6.12	0.02	.787
0.90	-22.76	31.25	2.82	5.54	0.02	.751
0.95	-16.55	29.89	2.97	5.03	0.03	.711
1.00	-11.02	29.09	3.17	4.59	0.03	.670
1.05	-6.20	28.75	3.41	4.22	0.03	.634
1.10	-1.66	28.88	3.69	3.91	0.03	.604
1.15	2.07	29.85	4.00	3.73	0.03	.589
1.20	4.94	31.37	4.28	3.66	0.03	.585
1.25	6.80	33.15	4.51	3.68	0.03	.589
1.30	7.90	34.63	4.66	3.72	0.03	.593
1.35	8.71	35.75	4.77	3.75	0.03	.597
1.40	9.23	36.85	4.86	3.79	0.03	.601
1.45	9.62	37.79	4.93	3.83	0.02	.604
1.50	9.72	38.86	4.99	3.89	0.02	.609
1.55	9.81	39.73	5.04	3.94	0.02	.613
1.60	9.59	40.95	5.08	4.03	0.02	.618
1.65	9.16	41.99	5.11	4.11	0.02	.623
1.70	8.48	43.19	5.12	4.22	0.02	.629
1.80	6.21	45.42	5.10	4.45	0.02	.642
1.90	1.81	47.42	4.96	4.78	0.02	.660
2.00	-4.26	46.66	4.61	5.06	0.02	.677
2.10	-8.12	42.83	4.21	5.09	0.02	.682
2.15	-8.89	40.82	4.05	5.03	0.02	.681
2.20	-9.53	39.40	3.94	5.00	0.02	.681
2.25	-10.35	38.13	3.82	4.99	0.02	.683
2.30	-11.15	36.70	3.69	4.97	0.02	.684
2.35	-11.72	35.14	3.56	4.94	0.03	.685
2.40	-11.96	33.63	3.44	4.89	0.03	.684
2.50	-12.06	31.17	3.27	4.77	0.03	.681
2.60	-11.86	29.30	3.14	4.66	0.03	.677
2.70	-11.67	28.11	3.06	4.59	0.03	.674
2.80	-12.10	27.10	2.99	4.59	0.03	.676
2.90	-13.29	26.58	2.87	4.64	0.03	.696
3.00	-15.05	24.77	2.64	4.69	0.03	.701

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
3.10	-15.76	22.29	2.40	4.64	0.03	.710
3.20	-15.95	19.89	2.18	4.55	0.03	.717
3.30	-15.65	17.70	2.00	4.43	0.03	.721
3.40	-15.11	15.81	1.84	4.30	0.03	.723
3.50	-14.42	14.22	1.71	4.16	0.03	.723
3.60	-13.70	12.88	1.60	4.03	0.04	.722
3.70	-13.00	11.69	1.50	3.90	0.04	.721
3.80	-12.24	10.66	1.41	3.77	0.04	.718
3.90	-11.47	9.81	1.35	3.64	0.04	.713
4.00	-10.75	9.13	1.29	3.53	0.05	.707
4.10	-10.11	8.54	1.25	3.42	0.05	.701
4.20	-9.50	8.03	1.21	3.31	0.05	.694
4.30	-8.93	7.61	1.18	3.21	0.06	.686
4.40	-8.44	7.23	1.16	3.13	0.06	.679
4.50	-7.95	6.94	1.14	3.04	0.06	.670
4.60	-7.56	6.70	1.13	2.97	0.07	.662
4.70	-7.24	6.47	1.11	2.91	0.07	.656
4.80	-6.98	6.22	1.09	2.86	0.07	.652
4.90	-6.74	5.96	1.06	2.81	0.07	.650
5.00	-6.52	5.68	1.03	2.75	0.08	.648
5.10	-6.28	5.39	1.00	2.70	0.08	.646
5.20	-6.03	5.11	0.97	2.64	0.08	.643
5.30	-5.78	4.84	0.94	2.58	0.09	.640
5.40	-5.51	4.59	0.91	2.52	0.09	.635
5.50	-5.22	4.41	0.90	2.45	0.09	.627
5.60	-4.99	4.21	0.88	2.40	0.10	.622
5.70	-4.73	4.06	0.87	2.34	0.10	.613
5.80	-4.51	3.93	0.86	2.29	0.11	.605
5.90	-4.31	3.80	0.85	2.24	0.12	.598
6.00	-4.12	3.68	0.84	2.20	0.12	.591
6.20	-3.77	3.48	0.82	2.11	0.13	.576
6.40	-3.49	3.29	0.81	2.04	0.14	.564
6.60	-3.26	3.07	0.78	1.97	0.15	.556
6.80	-3.01	2.88	0.76	1.89	0.17	.545
7.00	-2.79	2.66	0.73	1.82	0.18	.538
7.20	-2.56	2.46	0.70	1.75	0.20	.527
7.40	-2.32	2.28	0.68	1.67	0.22	.513
7.60	-2.08	2.13	0.67	1.59	0.24	.496
7.80	-1.85	2.00	0.66	1.51	0.27	.476
8.00	-1.63	1.88	0.66	1.44	0.30	.454
8.20	-1.43	1.78	0.65	1.36	0.34	.430
8.40	-1.23	1.71	0.66	1.29	0.39	.403
8.60	-1.06	1.62	0.66	1.22	0.43	.378
8.80	-0.87	1.56	0.68	1.15	0.49	.346
9.00	-0.71	1.50	0.69	1.09	0.54	.317
9.20	-0.55	1.44	0.70	1.02	0.61	.286
9.40	-0.37	1.40	0.73	0.95	0.67	.251
9.60	-0.20	1.37	0.77	0.89	0.71	.216
9.80	-0.04	1.37	0.82	0.84	0.73	.185
10.00	0.09	1.38	0.86	0.81	0.72	.163
10.20	0.22	1.38	0.90	0.77	0.71	.143
10.40	0.35	1.40	0.94	0.74	0.67	.127
10.60	0.47	1.42	0.99	0.72	0.63	.115
10.80	0.57	1.46	1.04	0.71	0.59	.105
11.00	0.66	1.51	1.08	0.70	0.55	.104
11.20	0.74	1.56	1.11	0.70	0.52	.102
11.40	0.81	1.61	1.14	0.70	0.50	.101

Ru $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
11.60	0.87	1.66	1.17	0.71	0.47	.102
11.80	0.92	1.72	1.20	0.72	0.45	.104
12.00	0.96	1.79	1.22	0.73	0.43	.107
12.20	0.97	1.85	1.24	0.75	0.42	.111
12.40	0.98	1.90	1.25	0.76	0.42	.113
12.60	0.96	1.94	1.25	0.77	0.41	.116
12.80	0.99	1.97	1.26	0.78	0.41	.118
13.00	0.99	2.01	1.27	0.79	0.40	.121
13.20	0.97	2.05	1.27	0.81	0.40	.124
13.40	0.95	2.08	1.27	0.82	0.40	.127
13.60	0.93	2.09	1.27	0.83	0.40	.129
13.80	0.90	2.11	1.26	0.83	0.40	.131
14.00	0.88	2.11	1.26	0.84	0.40	.132
14.20	0.87	2.10	1.25	0.84	0.41	.132
14.40	0.87	2.10	1.25	0.84	0.41	.132
14.60	0.86	2.10	1.25	0.84	0.41	.133
14.80	0.85	2.10	1.25	0.84	0.41	.133
15.00	0.85	2.10	1.25	0.84	0.41	.133
15.20	0.85	2.10	1.25	0.84	0.41	.133
15.40	0.86	2.11	1.25	0.84	0.41	.133
15.60	0.86	2.12	1.25	0.85	0.41	.134
15.80	0.87	2.13	1.26	0.85	0.40	.134
16.00	0.89	2.14	1.27	0.85	0.40	.134
16.25	0.89	2.22	1.28	0.87	0.39	.139
16.50	0.86	2.29	1.28	0.89	0.38	.145
16.75	0.81	2.35	1.28	0.91	0.38	.151
17.00	0.75	2.40	1.28	0.94	0.38	.158
17.25	0.67	2.45	1.27	0.97	0.38	.165
17.50	0.56	2.48	1.25	1.00	0.38	.175
17.75	0.45	2.48	1.22	1.02	0.39	.182
18.00	0.33	2.47	1.19	1.04	0.40	.190
18.25	0.22	2.42	1.15	1.05	0.41	.196
18.50	0.15	2.35	1.12	1.05	0.42	.200
18.75	0.09	2.28	1.09	1.05	0.44	.202
19.00	0.04	2.23	1.07	1.05	0.45	.205
19.25	-0.01	2.18	1.04	1.05	0.46	.208
19.50	-0.06	2.12	1.02	1.04	0.47	.212
19.75	-0.10	2.07	0.99	1.04	0.48	.215
20.00	-0.15	2.01	0.97	1.04	0.49	.219
20.25	-0.20	1.95	0.94	1.04	0.51	.223
20.50	-0.24	1.88	0.91	1.03	0.52	.228
20.75	-0.27	1.80	0.88	1.02	0.54	.231
21.00	-0.29	1.72	0.85	1.01	0.57	.234
21.25	-0.30	1.64	0.82	0.99	0.59	.235
21.50	-0.30	1.56	0.80	0.97	0.62	.234
21.75	-0.30	1.50	0.79	0.95	0.64	.234
22.00	-0.29	1.44	0.77	0.94	0.67	.233
22.50	-0.27	1.33	0.74	0.90	0.72	.230
23.00	-0.25	1.23	0.71	0.87	0.78	.226
23.50	-0.22	1.13	0.68	0.83	0.85	.223
24.00	-0.19	1.05	0.67	0.79	0.92	.218
24.50	-0.15	0.98	0.65	0.76	0.99	.212
25.00	-0.12	0.92	0.64	0.73	1.07	.205
25.50	-0.09	0.86	0.62	0.69	1.14	.200
26.00	-0.06	0.81	0.61	0.66	1.23	.194
26.50	-0.03	0.76	0.60	0.63	1.32	.185
27.00	0.01	0.71	0.60	0.59	1.41	.177

Ru $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
27.50	0.05	0.67	0.60	0.56	1.49	.165
28.00	0.08	0.63	0.60	0.53	1.55	.155
28.50	0.11	0.61	0.61	0.50	1.59	.144
29.00	0.15	0.58	0.61	0.48	1.61	.134
29.50	0.17	0.57	0.62	0.46	1.61	.126
30.00	0.18	0.55	0.62	0.45	1.64	.123
30.50	0.19	0.52	0.61	0.43	1.70	.120
31.00	0.21	0.48	0.61	0.40	1.74	.114
31.50	0.24	0.45	0.62	0.37	1.72	.104
32.00	0.28	0.43	0.63	0.34	1.65	.093
32.50	0.31	0.42	0.64	0.32	1.56	.083
33.00	0.33	0.41	0.65	0.31	1.49	.077
33.50	0.35	0.39	0.66	0.30	1.42	.071
34.00	0.37	0.38	0.67	0.28	1.34	.065
34.50	0.39	0.37	0.68	0.27	1.28	.060
35.00	0.42	0.36	0.70	0.26	1.18	.054
36.00	0.45	0.35	0.72	0.25	1.07	.047
37.00	0.48	0.34	0.73	0.23	0.97	.041
38.00	0.52	0.33	0.75	0.22	0.87	.035
39.00	0.55	0.34	0.77	0.22	0.81	.031
40.00	0.58	0.35	0.79	0.22	0.77	.028

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Rh
				Film	X-tal	Bulk	Prep		
We75									discussion paper
W076	20-250	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
WOL77	0.2-50	Refl	4.2 for $h\nu < 4.4$ eV 300 for $h\nu > 4.4$ eV			x	EP	R; KK: $\varepsilon_1, \varepsilon_2, \sigma$, $\mathrm{Im}(\varepsilon^{-1}), \mathrm{Im}(\varepsilon+1)^{-1}$	absorption measured by calorimetry at $h\nu < 4.4$ eV, reflectivity measured at $h\nu > 4.4$ eV with synchrotron radition; aqua regia + vacuum annealing
Da Unpl	~5-34								energy loss spectroscopy

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Rh
				Film	X-tal	Bulk	Prep		
HT59	5.64-20	Refl					Ex	R	
MC61	6.2-24.8	Trans, Refl		x			In	R	
LP62	1.88-2.82	Ellips				x	MP	n,k	table λ,n,k at 4 energies of Rh-Pt alloys
DH64	0.06-5.64	Refl		x			Ex	R	
BC67	0.11-3.1	Ellips				x	MP	n,k	
VAK67	3-14.4					x		R	polarimetry $3 < h\nu < 5$ eV, reflectance $4 < h\nu < 7$ eV, photoemission $7.5 < h\nu < 14.4$ eV
KNB68	5-12	Ellips				x		R; KK: $\sigma, \mathrm{Im}(\varepsilon^{-1})$, $\mathrm{Im}(\varepsilon+1)^{-1}$	data taken from VAK67, then KK analyzed
SR70	1-50	m-θ		x			Ex	R; $\varepsilon_1, \varepsilon_2, \mathrm{Im}(\varepsilon^{-1})$	optical constants determined by both KK analysis and two angles of incidence technique
CHH71	6.2-82.6	m-θ		x			Ex	R,n,k,$\varepsilon_1, \varepsilon_2$	plotted data are for substrate T = 573°K; evap. at $\leq 10^{-6}$ Torr
Hu71	6.2-53	Refl		x			Ex	R	
CoH73	0.56-6.2			x				R,n,k	three techniques used: reflectance + transmittance, ellipsometric, and multi-angle. Plotted data are for substrate T = 573°K
PS73	0.5-11.7	Refl		x			In	R; KK: $\varepsilon_1, \varepsilon_2, \sigma$, $\mathrm{Im}(\varepsilon^{-1}), \mathrm{Im}(\varepsilon+1)^{-1}$	uhv film preparation in situ

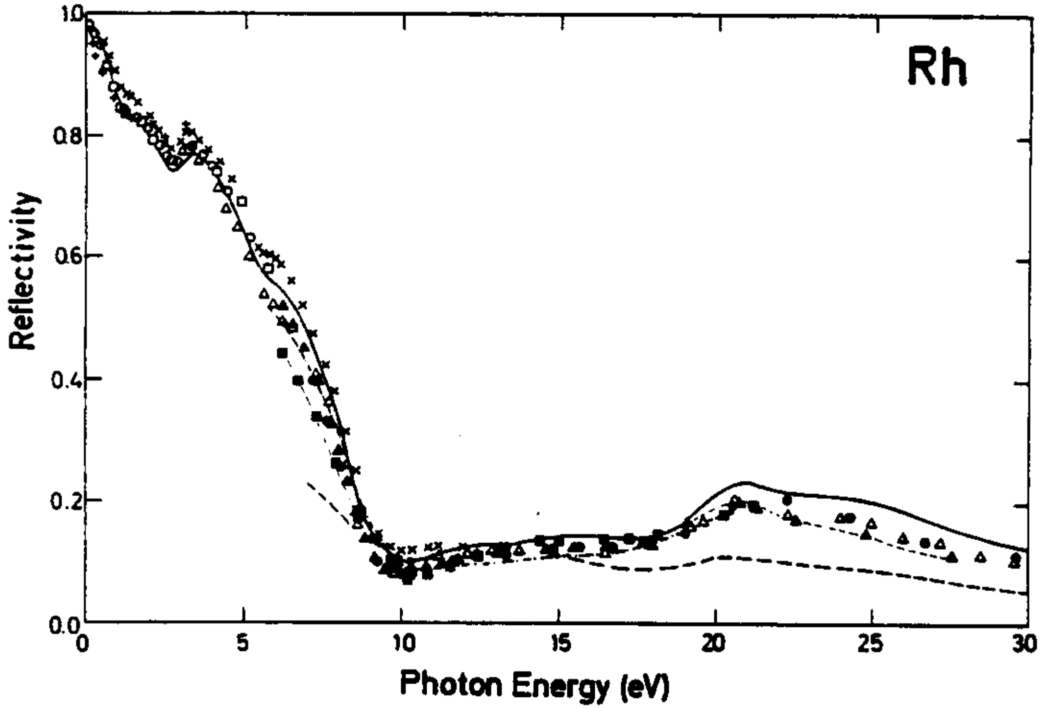

Fig. 58 Reflectivity for Rh. —— WOL77; --- MC61; □□□ CHR73; ●●● Hu71; ■■■HT59; ΔΔΔ SR70; ooo DH64; ▲▲▲ CHH71; +++ BC67; --- Da (unpub); xxx PS73.

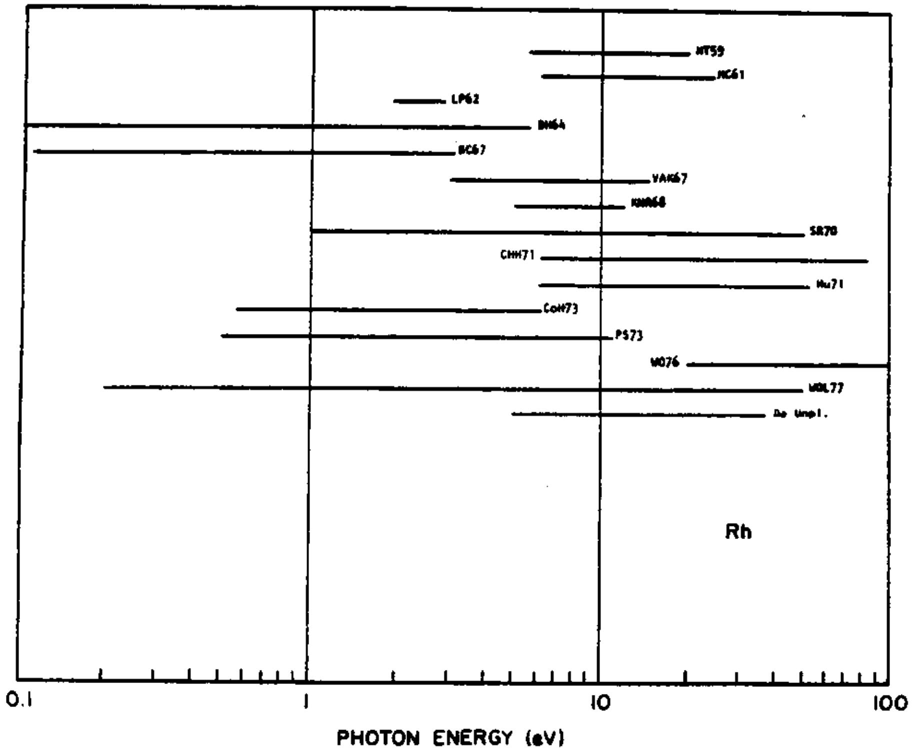

Fig. 57 Survey of available data for Rh

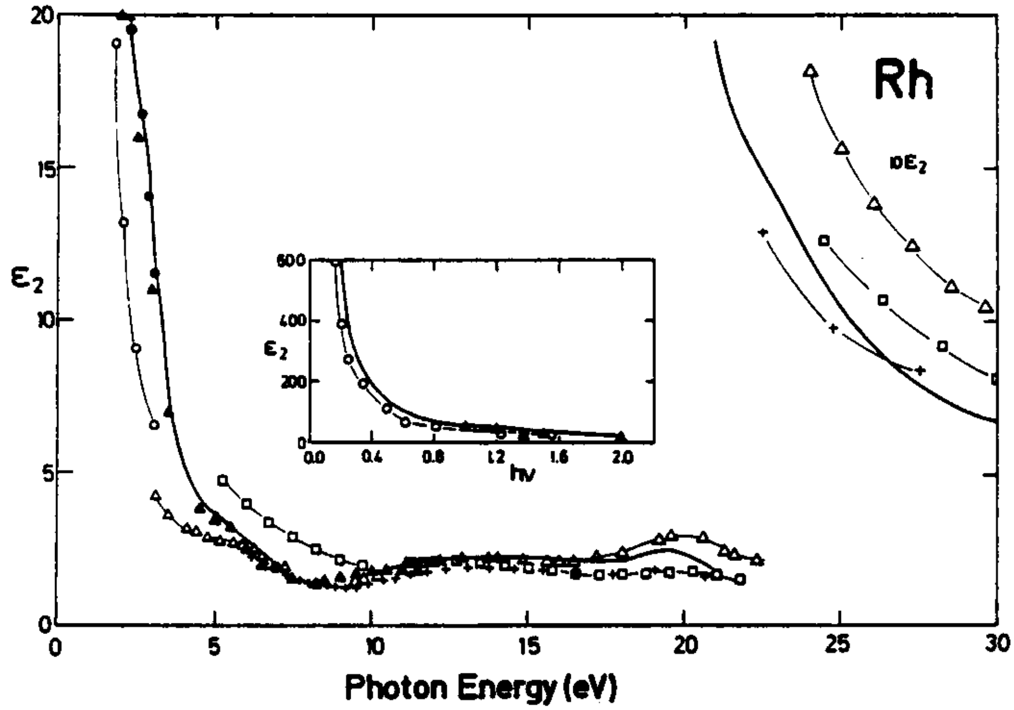

Fig. 60 ε_2 for Rh. —— WOL77; ΔΔΔ SR70; +++ CHH71; □□□ Da (unpub); ▲▲▲ PS73; ○○○ BC67; ●●● CHR73.

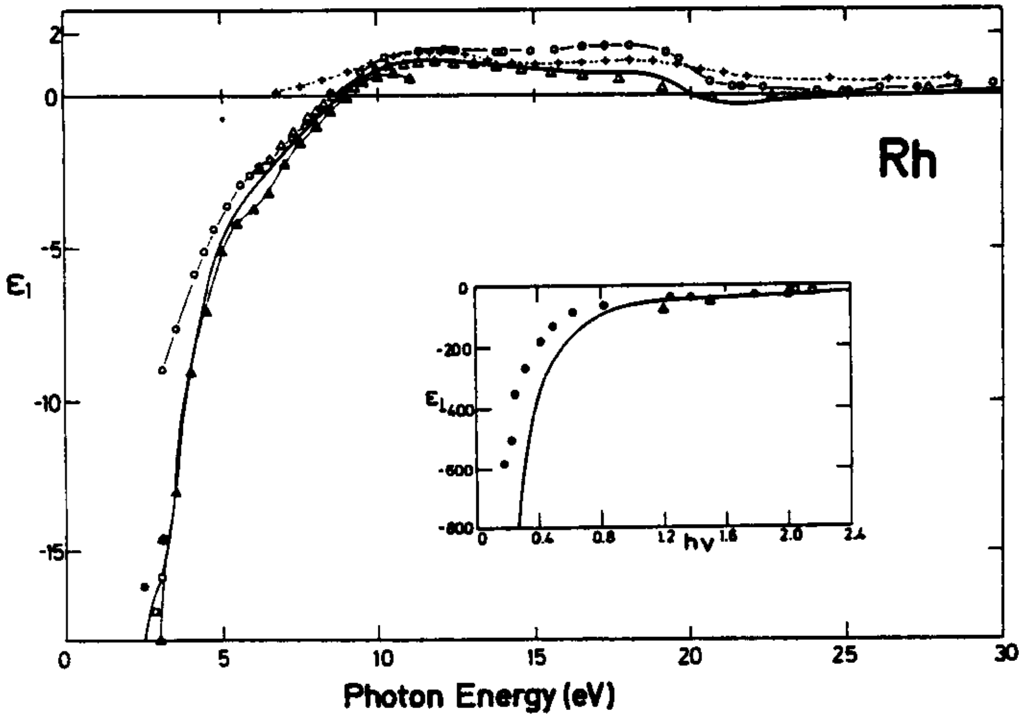

Fig. 59 ε_1 for Rh. —— WOL77; ○○○ SR60; ΔΔΔ CHH71; +++ Da (unpub); ▲▲▲ PS73; ●●● BC67; □□□ CHR73.

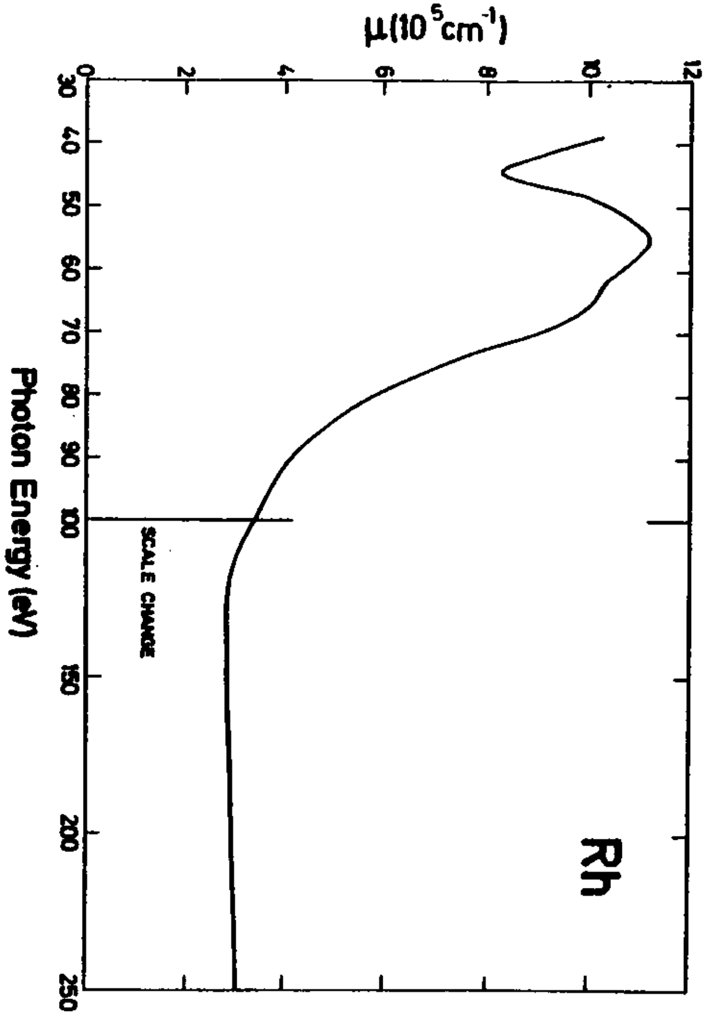

Fig. 61 Absorption coefficient for Rh reported by W076.

Rhodium

publication by J.H. Weaver, C.G. Olson, and D.W. Lynch in Phys. Rev. B, 4115 (1977) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
0.10	-4478.50	2565.33	18.48	69.43	0.00	.986
0.15	-2228.19	1117.16	11.50	48.58	0.00	.982
0.20	-1327.94	648.56	8.66	37.46	0.00	.977
0.25	-891.09	429.88	7.01	30.66	0.00	.972
0.30	-638.87	303.34	5.85	25.94	0.00	.967
0.35	-475.63	234.24	5.22	22.43	0.00	.961
0.40	-369.43	187.84	4.74	19.80	0.00	.955
0.45	-294.14	157.51	4.45	17.72	0.00	.948
0.50	-240.71	134.97	4.20	16.07	0.00	.941
0.55	-200.17	116.57	3.97	14.69	0.00	.934
0.60	-167.48	104.53	3.87	13.51	0.00	.925
0.65	-143.33	94.73	3.77	12.55	0.00	.916
0.70	-123.86	86.11	3.67	11.72	0.00	.908
0.75	-107.19	79.71	3.63	10.97	0.00	.898
0.80	-93.74	74.98	3.63	10.34	0.01	.887
0.85	-82.95	71.44	3.64	9.81	0.01	.876
0.90	-74.53	67.70	3.62	9.36	0.01	.867
0.95	-66.24	65.99	3.69	8.94	0.01	.855
1.00	-61.37	64.40	3.71	8.67	0.01	.848
1.05	-57.36	62.70	3.72	8.44	0.01	.841
1.10	-54.72	60.67	3.67	8.26	0.01	.837
1.15	-52.53	58.29	3.60	8.09	0.01	.834
1.20	-50.78	55.70	3.51	7.94	0.01	.832
1.25	-49.31	52.74	3.38	7.80	0.01	.831
1.30	-47.60	49.75	3.26	7.63	0.01	.829
1.40	-44.34	43.96	3.01	7.31	0.01	.827
1.50	-40.85	38.69	2.78	6.97	0.01	.823
1.60	-37.29	34.45	2.60	6.64	0.01	.818
1.70	-34.24	30.63	2.42	6.33	0.01	.813
1.80	-31.01	27.69	2.30	6.02	0.02	.805
1.90	-28.34	25.29	2.20	5.76	0.02	.798
2.00	-25.92	23.34	2.12	5.51	0.02	.789
2.10	-23.86	21.75	2.05	5.30	0.02	.780
2.20	-22.12	20.41	2.00	5.11	0.02	.772
2.30	-20.64	19.14	1.94	4.94	0.02	.765
2.40	-19.18	18.18	1.90	4.78	0.03	.756
2.50	-18.05	17.48	1.88	4.65	0.03	.749
2.60	-17.29	16.88	1.85	4.55	0.03	.743
2.70	-16.87	16.18	1.80	4.49	0.03	.742
2.90	-16.36	14.26	1.63	4.36	0.03	.748
3.00	-16.05	13.10	1.53	4.29	0.03	.753
3.10	-15.65	11.64	1.41	4.20	0.03	.760
3.20	-15.02	10.64	1.30	4.09	0.03	.764
3.30	-14.31	9.55	1.20	3.97	0.03	.767
3.40	-13.53	8.55	1.11	3.84	0.03	.769
3.50	-12.67	7.71	1.04	3.71	0.04	.769
3.60	-11.80	7.06	0.99	3.58	0.04	.764
3.70	-11.02	6.54	0.95	3.45	0.04	.759
3.80	-10.30	6.10	0.91	3.34	0.04	.754

Energy (eV)	ε_1	ε_2	n	k	$\text{Im}(-1/\tilde{\varepsilon})$	$R(\phi=0)$
3.90	-9.64	5.70	0.88	3.23	0.05	.747
4.00	-9.00	5.39	0.86	3.12	0.05	.739
4.10	-8.44	5.11	0.84	3.03	0.05	.731
4.20	-7.93	4.89	0.83	2.94	0.06	.722
4.30	-7.49	4.58	0.80	2.85	0.06	.719
4.40	-6.97	4.39	0.80	2.76	0.06	.706
4.50	-6.54	4.21	0.79	2.68	0.07	.696
4.60	-6.12	4.06	0.78	2.60	0.08	.684
4.70	-5.74	3.97	0.79	2.52	0.08	.670
4.80	-5.41	3.86	0.79	2.46	0.09	.659
4.90	-5.09	3.79	0.79	2.39	0.09	.645
5.00	-4.84	3.69	0.79	2.34	0.10	.635
5.20	-4.34	3.54	0.79	2.23	0.11	.613
5.40	-3.93	3.41	0.80	2.14	0.13	.591
5.60	-3.61	3.30	0.80	2.06	0.14	.573
5.80	-3.37	3.15	0.79	2.00	0.15	.561
6.00	-3.16	2.92	0.76	1.93	0.16	.556
6.20	-2.89	2.71	0.73	1.85	0.17	.544
6.40	-2.65	2.50	0.70	1.77	0.19	.534
6.60	-2.38	2.31	0.68	1.69	0.21	.518
6.80	-2.11	2.15	0.67	1.60	0.24	.498
7.00	-1.86	2.02	0.66	1.52	0.27	.476
7.20	-1.62	1.89	0.66	1.43	0.30	.452
7.40	-1.39	1.79	0.66	1.35	0.35	.423
7.60	-1.18	1.70	0.67	1.27	0.40	.394
7.80	-0.98	1.62	0.68	1.20	0.45	.363
8.00	-0.78	1.53	0.69	1.12	0.52	.329
8.20	-0.56	1.48	0.71	1.04	0.59	.288
8.40	-0.38	1.43	0.74	0.97	0.65	.252
8.60	-0.18	1.40	0.78	0.89	0.70	.212
8.80	0.00	1.38	0.83	0.83	0.73	.179
9.00	0.18	1.37	0.88	0.77	0.72	.148
9.20	0.36	1.39	0.95	0.73	0.68	.125
9.40	0.52	1.42	1.01	0.71	0.62	.110
9.60	0.65	1.48	1.07	0.69	0.57	.102
9.80	0.78	1.53	1.12	0.69	0.52	.098
10.00	0.88	1.62	1.17	0.69	0.48	.098
10.20	0.96	1.69	1.21	0.70	0.45	.100
10.40	1.01	1.77	1.24	0.72	0.42	.104
10.60	1.06	1.84	1.26	0.73	0.41	.106
10.80	1.08	1.91	1.28	0.75	0.40	.110
11.00	1.10	1.96	1.29	0.76	0.39	.113
11.20	1.12	2.01	1.31	0.77	0.38	.116
11.40	1.12	2.07	1.32	0.79	0.37	.120
11.60	1.10	2.12	1.32	0.80	0.37	.124
11.80	1.08	2.14	1.32	0.81	0.37	.126
12.00	1.07	2.15	1.32	0.82	0.37	.127
12.20	1.06	2.16	1.32	0.82	0.37	.128
12.40	1.05	2.17	1.32	0.82	0.37	.129
12.60	1.05	2.17	1.32	0.82	0.37	.129
12.80	1.05	2.18	1.32	0.83	0.37	.130
13.00	1.04	2.19	1.32	0.83	0.37	.131
13.20	1.04	2.21	1.32	0.84	0.37	.132
13.40	1.03	2.22	1.32	0.84	0.37	.133
13.60	1.03	2.23	1.32	0.85	0.37	.134
13.80	1.02	2.26	1.32	0.85	0.37	.136
14.00	1.00	2.27	1.32	0.86	0.37	.138
14.20	0.97	2.29	1.32	0.87	0.37	.140
14.40	0.94	2.30	1.31	0.88	0.37	.142
14.60	0.91	2.31	1.30	0.89	0.37	.144
14.80	0.87	2.31	1.29	0.89	0.38	.146
15.00	0.83	2.30	1.28	0.90	0.38	.147
15.20	0.80	2.29	1.27	0.90	0.39	.148
15.40	0.78	2.25	1.26	0.90	0.40	.147
15.60	0.76	2.24	1.25	0.90	0.40	.147
15.80	0.75	2.21	1.24	0.89	0.41	.147
16.00	0.73	2.20	1.24	0.89	0.41	.147
16.25	0.72	2.18	1.23	0.89	0.41	.146
16.50	0.72	2.16	1.23	0.88	0.42	.145
16.75	0.71	2.15	1.22	0.88	0.42	.145
17.00	0.71	2.14	1.22	0.88	0.42	.144
17.25	0.71	2.14	1.22	0.88	0.42	.144
17.50	0.72	2.13	1.22	0.87	0.42	.143
17.75	0.73	2.15	1.23	0.88	0.42	.144
18.00	0.74	2.18	1.23	0.88	0.41	.145
18.25	0.73	2.23	1.24	0.90	0.40	.149
18.50	0.70	2.30	1.25	0.92	0.40	.155
18.75	0.65	2.36	1.25	0.95	0.39	.162
19.00	0.56	2.43	1.24	0.98	0.39	.172
19.25	0.43	2.47	1.21	1.02	0.39	.183
19.50	0.29	2.47	1.18	1.05	0.40	.193
19.75	0.17	2.44	1.14	1.07	0.41	.202
20.00	0.03	2.38	1.10	1.09	0.42	.213
20.25	-0.09	2.30	1.05	1.09	0.43	.221
20.50	-0.19	2.18	1.00	1.09	0.45	.230
20.75	-0.25	2.05	0.95	1.08	0.48	.233
21.00	-0.27	1.92	0.91	1.05	0.51	.234
21.25	-0.28	1.81	0.88	1.03	0.54	.232
21.50	-0.25	1.72	0.86	1.00	0.57	.228
21.75	-0.24	1.64	0.84	0.97	0.60	.224
22.00	-0.21	1.58	0.83	0.95	0.62	.219
22.25	-0.19	1.54	0.82	0.93	0.64	.215
22.50	-0.19	1.50	0.81	0.92	0.66	.214
22.75	-0.19	1.46	0.80	0.91	0.68	.213
23.00	-0.19	1.42	0.79	0.90	0.69	.213
23.25	-0.19	1.37	0.77	0.89	0.72	.214
23.50	-0.19	1.32	0.75	0.87	0.74	.214
23.75	-0.18	1.27	0.74	0.86	0.77	.212
24.00	-0.17	1.23	0.73	0.84	0.80	.210
24.25	-0.17	1.18	0.72	0.83	0.83	.210
24.50	-0.16	1.14	0.70	0.81	0.86	.208
24.75	-0.14	1.10	0.69	0.79	0.90	.206
25.00	-0.12	1.06	0.69	0.77	0.93	.202
25.25	-0.11	1.02	0.68	0.75	0.97	.199
25.50	-0.09	0.99	0.67	0.74	1.00	.195
25.75	-0.08	0.95	0.66	0.72	1.04	.193
26.00	-0.06	0.92	0.66	0.70	1.08	.188
26.25	-0.04	0.89	0.65	0.68	1.12	.182
26.50	-0.01	0.87	0.65	0.66	1.15	.176
26.75	0.01	0.85	0.65	0.65	1.17	.171
27.00	0.02	0.83	0.65	0.64	1.20	.168
27.25	0.04	0.81	0.65	0.62	1.23	.163
27.50	0.05	0.80	0.65	0.61	1.25	.159
27.75	0.07	0.78	0.65	0.60	1.27	.155

Rh

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(ϕ=0)
28.00	0.08	0.76	0.65	0.59	1.30	.152
28.50	0.11	0.73	0.65	0.56	1.34	.144
29.00	0.13	0.71	0.65	0.54	1.37	.137
29.50	0.16	0.69	0.66	0.52	1.38	.130
30.00	0.17	0.67	0.66	0.51	1.40	.127
31.00	0.17	0.62	0.64	0.49	1.50	.127
32.00	0.17	0.54	0.61	0.44	1.69	.126
33.00	0.22	0.44	0.60	0.37	1.82	.110
34.00	0.34	0.39	0.65	0.30	1.46	.074
35.00	0.41	0.39	0.69	0.28	1.23	.058
36.00	0.45	0.40	0.73	0.27	1.09	.049
37.00	0.46	0.41	0.74	0.28	1.07	.047
38.00	0.47	0.40	0.74	0.27	1.04	.045
39.00	0.49	0.38	0.75	0.25	0.98	.041

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Pd
				Film	X-tal	Bulk	Prep		
Sa39	2.6-27.6	Refl		x			Ex	R	
MT57	~2.07-4.1	Trans, Refl		x			Ex	R,n,k	10^{-5} Torr
Lo64	1-6	Trans, Refl		x			Ex	R,T,n,k,$-\varepsilon_1$	
DM65	0.09-1.0	Ellips				x		n,k	table of λ,n,k
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,-\varepsilon_1$	
Ro66	3-60	m-θ		x			Ex	R,ε_1,ε_2,Im(ε^{-1})	plotted R at θ = 18°; plotted $\varepsilon_1,\varepsilon_2$ from a two angles of incidence technique
BKN67	0.07-13	Refl, Ellips				x	MP	n,k,R,σ,ε_1,ε_2, Im(ε^{-1}); KK: σ,ε_1,ε_2	R measured for hν > 4.13 eV, Beattie method hν < 5 eV
Le67	<4	Ellips				x	MP	ε_2/λ	data from LT66 and LTA66
VAK67	3-14.4					x	Ex	R	polarimetry 3 < E < 5 eV, reflectance 4 < hν < 7 eV, photoemission 7.5 < hν < 14.4 eV
R168	~0.8-7.7	Ellips		x				n,k,Im(ε^{-1})	
YS68	2.2-11.6	Refl		x			In	R; KK: ε_1,ε_2,σ, Im(ε^{-1}),μ	~10^{-8} Torr
Da69	5-75	Trans		x			Ex	Im(ε^{-1}); KK: ε_1,ε_2	energy loss spectroscopy
DFR70	2-30	Trans		x				Im(ε^{-1}),ε_1,ε_2,μ	energy loss spectroscopy

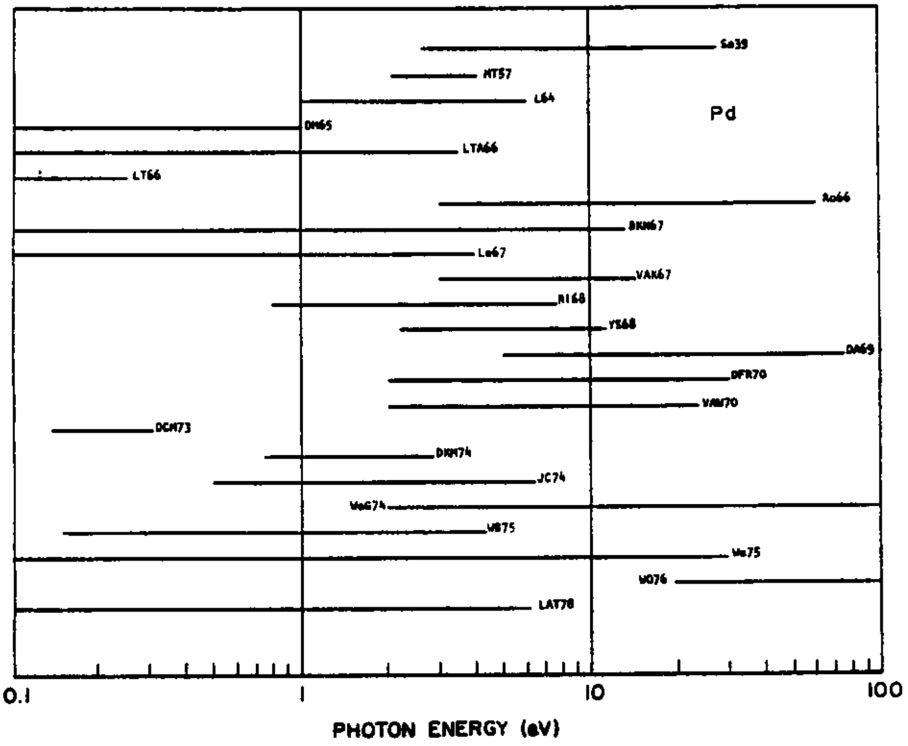

Fig. 62 Survey of available data for Pd

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Pd
				Film	X-tal	Bulk	Prep		
VAW70	2-24	Refl		x			In	R; KK; n,k,ε_1,ε_2,σ, Im(ε^{-1}), Im$(\varepsilon+1)^{-1}$	~10^{-8} Torr
DKM73	0.138-0.31	Ellips				x	EP	n,k	
DKM74	0.73-2.88	Ellips				x	EP	n,k,σ	
JC74	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	table of E,n,k
WG74	2-120	Trans		x				KK: μ	energy loss spectroscopy, then KK analysis
WB75	0.15-4.4	Refl	4.2			x	Heat	A; KK: σ	optical absorptivity; aqua regia and heating ~1300 K in He atmosphere
We75	0-30								discussion paper
WO76	20-250	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
LAT78	0.1-6.2	m-θ		x			Ex	n,k	surface plasmon excitation

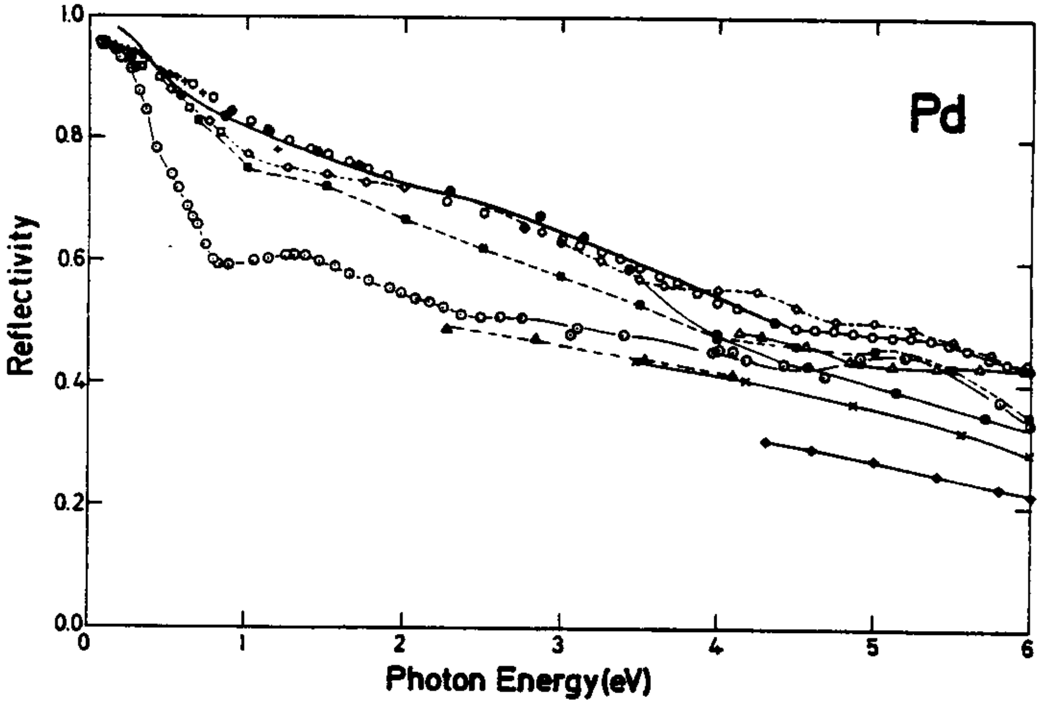

Fig. 64 Reflectivity of Pd for 0 ≤ hν ≤ 6 eV. —— WB75; ◇◇◇VAW70; ◆◆◆DFR70; ●●● YS68; xxx Ro66; ⊙⊙⊙ BKN67; ΔΔΔ VAK67; ooo JC74; +++ DKM73; ▲▲▲MT57; ■■■ Lo64; □□□ DM65.

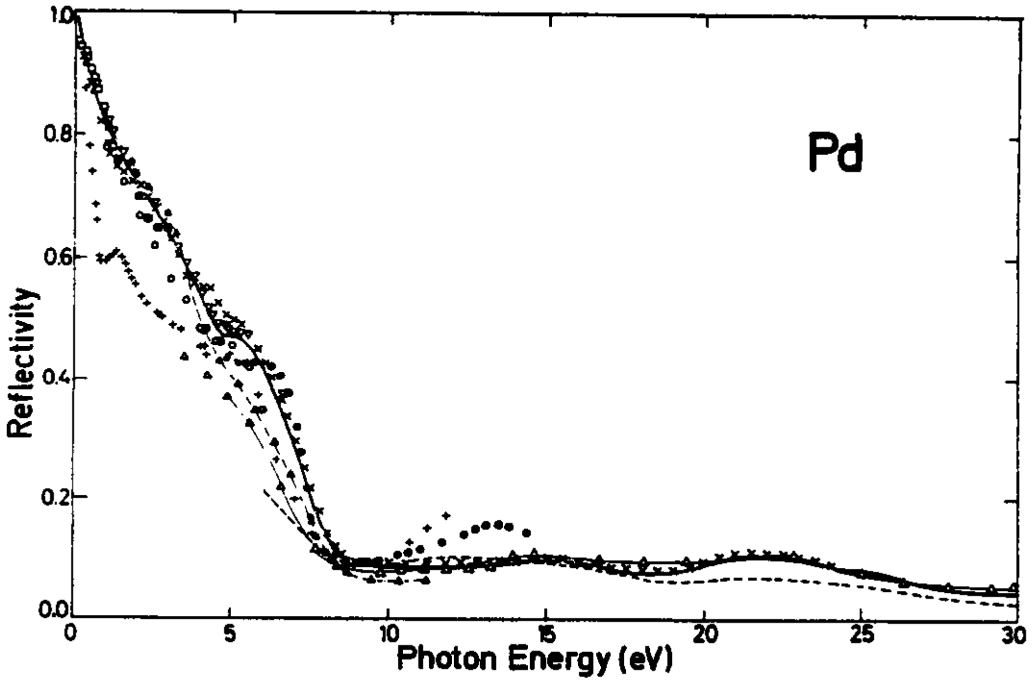

Fig. 63 Reflectivity of Pd. —— WB75; xxx VAW70; ΔΔΔ Ro66; ▲▲▲YS68; --- DFR70; +++ BKN67; ▽▽▽ JC74; ●●● VAK67; ooo Lo64; □□□ DKM73; ■■■DKM74.

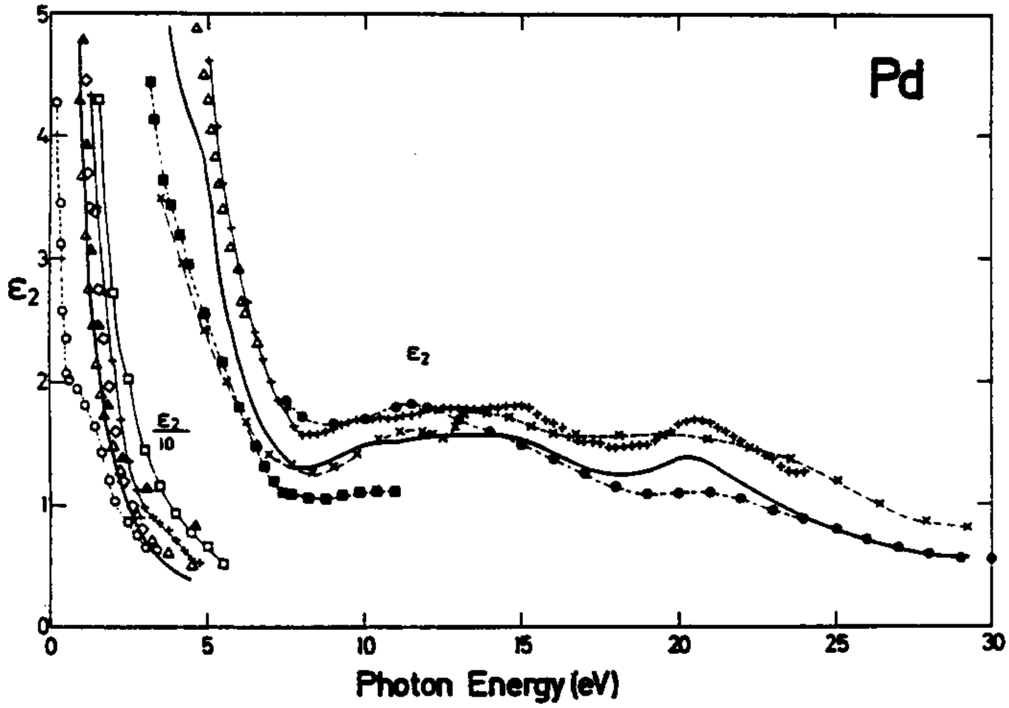

Fig. 66 ε_2 for Pd. —— WB75; xxx Ro66; ◇◇◇DKM74; ▲▲▲ RI68; △△△ JC74; □□□Lo64; ○○○ BKN67; ●●● DFR70; ■■■ YS68; +++ VAW70;

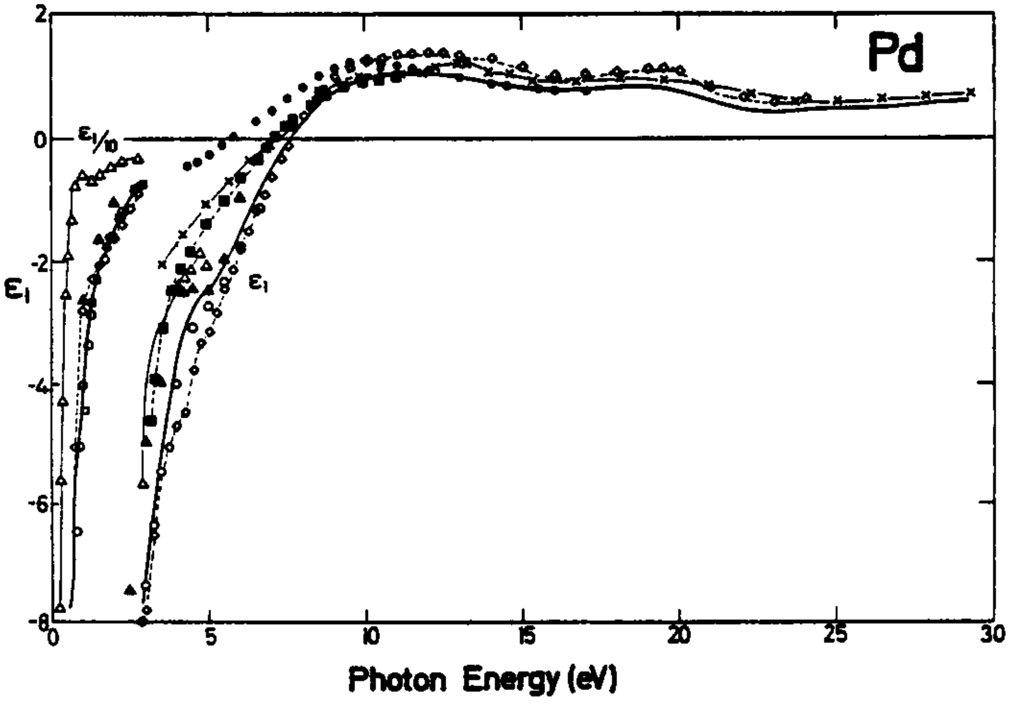

Fig. 65 ε_1 for Pd. —— WB75; xxx Ro66; □□□ DKM73; ○○○ JC74; ▲▲▲ Lo64; △△△ BKN67; ●●● DFR70; ■■■YS68; ◇◇◇VAW70.

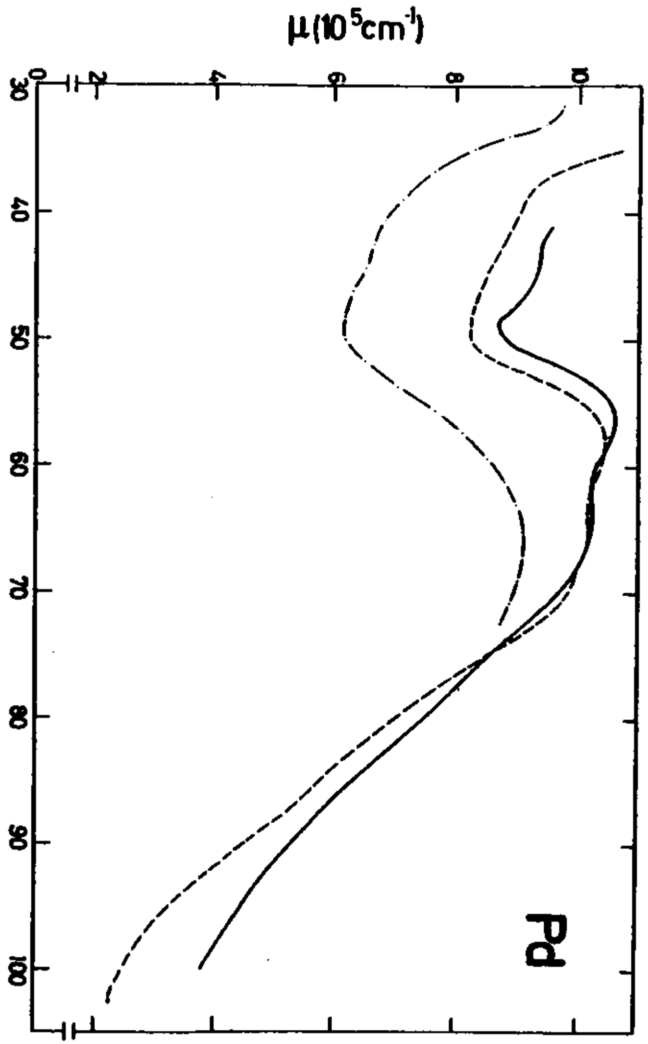

Fig. 67   Absorption coefficient for Pd. —— WO76; --- DFR70; -·- WG74.

Palladium

publication by J.H. Weaver and R.L. Benbow in Phys. Rev. B 12, 3509 (1975)
based on the following tabulation; data above 4 eV from other groups

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-2914.61	447.22	4.13	54.15	0.00	.994
0.11	-2406.39	378.64	3.85	49.21	0.00	.994
0.12	-2019.55	324.33	3.60	45.08	0.00	.993
0.13	-1712.91	279.30	3.36	41.52	0.00	.992
0.14	-1469.42	254.73	3.31	38.48	0.00	.991
0.15	-1273.08	224.57	3.13	35.82	0.00	.990
0.16	-1108.90	212.28	3.17	33.45	0.00	.989
0.17	-979.48	201.10	3.20	31.46	0.00	.987
0.18	-872.71	187.30	3.15	29.71	0.00	.986
0.19	-779.59	172.30	3.07	28.09	0.00	.985
0.20	-697.50	163.07	3.07	26.59	0.00	.983
0.22	-569.33	149.17	3.10	24.06	0.00	.979
0.24	-472.90	138.31	3.15	21.97	0.00	.975
0.26	-396.17	125.38	3.11	20.15	0.00	.971
0.28	-332.20	122.41	3.30	18.52	0.00	.964
0.30	-285.46	122.99	3.56	17.27	0.00	.955
0.32	-250.16	115.55	3.56	16.21	0.00	.950
0.34	-216.10	115.24	3.80	15.18	0.00	.940
0.36	-191.72	114.66	3.98	14.41	0.00	.932
0.38	-172.12	114.79	4.17	13.77	0.00	.923
0.40	-158.00	113.37	4.27	13.27	0.00	.916
0.42	-146.39	110.83	4.31	12.85	0.00	.911
0.44	-136.80	107.33	4.31	12.46	0.00	.906
0.46	-128.36	103.32	4.27	12.11	0.00	.902
0.48	-120.94	98.95	4.20	11.77	0.00	.899
0.50	-114.16	93.92	4.10	11.44	0.00	.896
0.52	-106.97	89.51	4.03	11.10	0.00	.891
0.54	-100.56	85.67	3.97	10.79	0.00	.887
0.56	-94.79	82.25	3.92	10.49	0.01	.883
0.58	-89.77	78.78	3.85	10.23	0.01	.880
0.60	-84.80	75.67	3.80	9.96	0.01	.876
0.64	-76.39	70.16	3.70	9.49	0.01	.868
0.68	-69.24	65.48	3.61	9.07	0.01	.860
0.72	-63.45	61.09	3.51	9.70	0.01	.854
0.76	-58.15	57.29	3.43	8.36	0.01	.847
0.80	-53.71	53.94	3.35	8.06	0.01	.840
0.84	-49.93	50.89	3.27	7.79	0.01	.834
0.88	-46.65	47.96	3.18	7.53	0.01	.829
0.92	-43.52	45.35	3.11	7.29	0.01	.822
0.96	-40.76	43.16	3.05	7.08	0.01	.816
1.00	-38.52	41.13	2.99	6.89	0.01	.811
1.05	-36.10	38.65	2.90	6.67	0.01	.806
1.10	-33.86	36.33	2.81	6.46	0.01	.800
1.15	-31.85	34.29	2.73	6.27	0.02	.795
1.20	-30.17	32.33	2.65	6.10	0.02	.790
1.25	-28.53	30.59	2.58	5.93	0.02	.785
1.30	-27.18	28.95	2.50	5.78	0.02	.791
1.35	-26.02	27.27	2.42	5.64	0.02	.778
1.40	-24.76	25.73	2.34	5.50	0.02	.774

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
1.45	-23.69	24.20	2.26	5.36	0.02	.771
1.50	-22.50	22.69	2.17	5.22	0.02	.767
1.55	-21.13	21.58	2.13	5.07	0.02	.760
1.60	-20.12	20.59	2.08	4.95	0.02	.755
1.65	-19.13	19.72	2.04	4.83	0.03	.749
1.70	-18.32	18.89	2.00	4.72	0.03	.745
1.75	-17.55	18.13	1.96	4.63	0.03	.740
1.80	-16.91	17.40	1.92	4.54	0.03	.737
1.85	-16.36	16.53	1.86	4.45	0.03	.734
1.90	-15.59	15.83	1.82	4.35	0.03	.729
1.95	-15.00	15.22	1.78	4.26	0.03	.725
2.00	-14.46	14.60	1.75	4.19	0.03	.721
2.10	-13.43	13.49	1.67	4.03	0.04	.714
2.20	-12.53	12.44	1.60	3.88	0.04	.707
2.30	-11.68	11.49	1.53	3.75	0.04	.700
2.40	-10.91	10.61	1.47	3.61	0.05	.693
2.50	-10.12	9.84	1.41	3.48	0.05	.685
2.60	-9.40	9.20	1.37	3.36	0.05	.676
2.70	-8.78	8.60	1.32	3.25	0.06	.668
2.80	-8.17	8.07	1.29	3.13	0.06	.658
2.90	-7.62	7.62	1.26	3.03	0.07	.648
3.00	-7.13	7.20	1.23	2.94	0.07	.639
3.10	-6.69	6.82	1.20	2.85	0.07	.630
3.20	-6.29	6.45	1.17	2.77	0.08	.622
3.30	-5.89	6.11	1.14	2.68	0.08	.613
3.40	-5.51	5.80	1.12	2.60	0.09	.602
3.50	-5.14	5.55	1.10	2.52	0.10	.591
3.60	-4.82	5.31	1.08	2.45	0.10	.581
3.70	-4.51	5.09	1.07	2.38	0.11	.570
3.80	-4.23	4.90	1.06	2.31	0.12	.558
3.90	-3.97	4.72	1.05	2.25	0.12	.547
4.00	-3.73	4.53	1.03	2.19	0.13	.537
4.10	-3.42	4.44	1.04	2.12	0.14	.519
4.20	-3.26	4.36	1.04	2.09	0.15	.510
4.40	-2.95	4.15	1.03	2.01	0.16	.493
4.50	-2.79	4.07	1.03	1.97	0.17	.483
4.60	-2.69	4.00	1.03	1.94	0.17	.476
4.70	-2.61	3.93	1.03	1.91	0.18	.472
4.80	-2.57	3.85	1.01	1.90	0.18	.470
4.90	-2.55	3.72	0.99	1.88	0.18	.471
5.00	-2.52	3.58	0.96	1.86	0.19	.472
5.10	-2.48	3.40	0.93	1.83	0.19	.474
5.20	-2.41	3.21	0.90	1.79	0.20	.474
5.30	-2.30	3.04	0.87	1.75	0.21	.470
5.40	-2.19	2.89	0.85	1.70	0.22	.463
5.60	-1.96	2.64	0.81	1.62	0.24	.449
5.80	-1.77	2.41	0.78	1.54	0.27	.437
6.00	-1.54	2.20	0.76	1.45	0.30	.418
6.20	-1.33	2.04	0.74	1.37	0.34	.397
6.40	-1.14	1.88	0.73	1.29	0.39	.375
6.60	-0.95	1.74	0.72	1.21	0.44	.350
6.80	-0.74	1.63	0.73	1.13	0.51	.316
7.00	-0.57	1.54	0.73	1.05	0.57	.297
7.20	-0.40	1.47	0.75	0.98	0.63	.255
7.40	-0.24	1.40	0.77	0.91	0.69	.223
7.60	-0.10	1.35	0.79	0.85	0.74	.195
7.80	0.07	1.29	0.83	0.78	0.77	.163

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
8.00	0.25	1.28	0.88	0.73	0.75	.133
8.20	0.38	1.32	0.94	0.70	0.70	.117
8.40	0.42	1.34	0.96	0.70	0.68	.114
8.60	0.57	1.31	1.00	0.65	0.64	.097
8.80	0.64	1.36	1.04	0.65	0.60	.094
9.00	0.72	1.38	1.07	0.64	0.57	.090
9.25	0.79	1.42	1.10	0.65	0.54	.089
9.50	0.83	1.46	1.12	0.65	0.52	.089
9.75	0.86	1.48	1.13	0.65	0.51	.089
10.00	0.88	1.49	1.14	0.65	0.50	.088
10.25	0.91	1.49	1.15	0.65	0.49	.087
10.50	0.93	1.51	1.16	0.65	0.48	.087
10.75	0.96	1.51	1.17	0.64	0.47	.096
11.00	0.98	1.52	1.18	0.64	0.46	.086
11.25	0.99	1.54	1.19	0.65	0.46	.087
11.50	1.00	1.54	1.19	0.65	0.46	.087
11.75	1.00	1.56	1.20	0.65	0.45	.089
12.00	1.00	1.57	1.20	0.66	0.45	.089
12.25	0.99	1.58	1.20	0.66	0.45	.090
12.50	0.98	1.59	1.19	0.67	0.46	.091
12.75	0.97	1.58	1.19	0.67	0.46	.091
13.00	0.96	1.58	1.18	0.67	0.46	.091
13.25	0.95	1.57	1.18	0.67	0.46	.091
13.50	0.94	1.58	1.18	0.67	0.47	.092
13.75	0.93	1.57	1.17	0.67	0.47	.092
14.00	0.92	1.57	1.17	0.67	0.47	.093
14.25	0.90	1.57	1.16	0.68	0.48	.094
14.50	0.87	1.57	1.15	0.68	0.49	.095
14.75	0.85	1.57	1.15	0.68	0.49	.096
15.00	0.81	1.56	1.13	0.69	0.51	.098
15.25	0.77	1.53	1.11	0.69	0.52	.098
15.50	0.75	1.48	1.10	0.68	0.54	.096
15.75	0.74	1.45	1.09	0.67	0.55	.094
16.00	0.73	1.42	1.08	0.66	0.56	.092
16.25	0.71	1.39	1.07	0.65	0.57	.091
16.50	0.73	1.34	1.06	0.63	0.58	.086
16.75	0.75	1.31	1.06	0.62	0.57	.082
17.00	0.77	1.31	1.07	0.61	0.57	.081
17.25	0.76	1.30	1.07	0.61	0.57	.081
17.50	0.76	1.29	1.06	0.61	0.58	.080
17.75	0.78	1.26	1.06	0.60	0.57	.078
18.00	0.79	1.26	1.07	0.59	0.57	.077
18.25	0.80	1.27	1.07	0.59	0.57	.077
18.50	0.80	1.27	1.07	0.59	0.56	.077
18.75	0.80	1.27	1.07	0.59	0.56	.077
19.00	0.81	1.28	1.08	0.59	0.56	.077
19.25	0.81	1.30	1.08	0.60	0.55	.079
19.50	0.80	1.32	1.08	0.61	0.55	.080
19.75	0.78	1.36	1.08	0.63	0.55	.094
20.00	0.73	1.39	1.07	0.65	0.56	.099
20.25	0.68	1.39	1.05	0.66	0.58	.094
20.50	0.62	1.36	1.03	0.67	0.60	.099
20.75	0.57	1.36	1.01	0.67	0.63	.101
21.00	0.52	1.33	0.99	0.67	0.65	.103
21.50	0.46	1.25	0.95	0.66	0.70	.103
22.00	0.42	1.17	0.91	0.64	0.76	.103
22.50	0.40	1.09	0.88	0.62	0.81	.101

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Hf
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
Le67	<4	Ellips				x	MP	ε_2/λ	data taken from LT66 and LTA66
GL68	2-5.6	m-θ				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
ABF72			1000<T<2200			x		ε at λ = 6500 Å	emissivity
LOW75	0.15-30	Refl	4.2 K for hν < 4.4 eV 300 K for hν > 4.4 eV		x	x	EP	A,R; KK; $\varepsilon_1,\varepsilon_2,\sigma$, $\mathrm{Im}(\varepsilon^{-1}),\mathrm{Im}(\varepsilon+1)^{-1}$	absorptivity by calorimetry for hν < 4.4 eV reflectivity for hν > 4.4 eV with synchrotron radiation
LT75	6.5-24.8	m-θ				x	In	$R,n,k,\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	heating ~1820 K at ~10^{-8} Torr in situ
WO76	20-250	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
BDL77	0.03-3.1	Refl				x		R	also emissivity 400-850 K
LO Unpb	0.12-30		4.2 K for hν < 4.4 eV RT for hν ≤ 4.4 eV		x			R; KK: $n,k,\varepsilon_1,\varepsilon_2$, $\mathrm{Im}(\varepsilon^{-1}),\mu$	absorptivity measured by calorimetry for hν < 4.4 eV, reflectivity measured for hν > 4.4 eV

Pd

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(φ=0)
23.00	0.39	1.02	0.86	0.59	0.86	.097
23.50	0.40	0.95	0.85	0.56	0.90	.091
24.00	0.42	0.90	0.84	0.54	0.91	.086
25.04	0.39	0.81	0.81	0.51	1.00	.084
26.40	0.45	0.68	0.80	0.43	1.02	.066
27.80	0.52	0.61	0.81	0.38	0.95	.052
29.20	0.54	0.58	0.82	0.35	0.92	.046

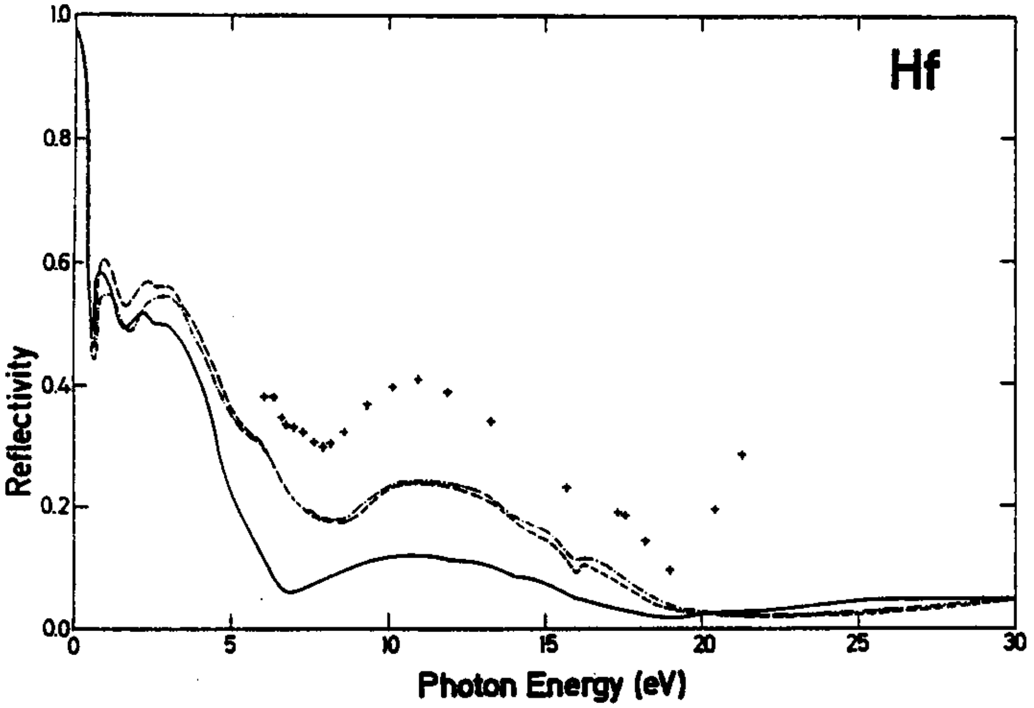

Fig. 69 Reflectivity of Hf. Results for single crystal Hf reported by WOL (unpub) for E∥c (–•–) and E⊥c (–––) judged by the authors to be superior to their earlier published polycrystalline data LOW75 (——); single crystal results shown in tabulation for Hf. Polycrystalline data shown as follows: +++ LT75.

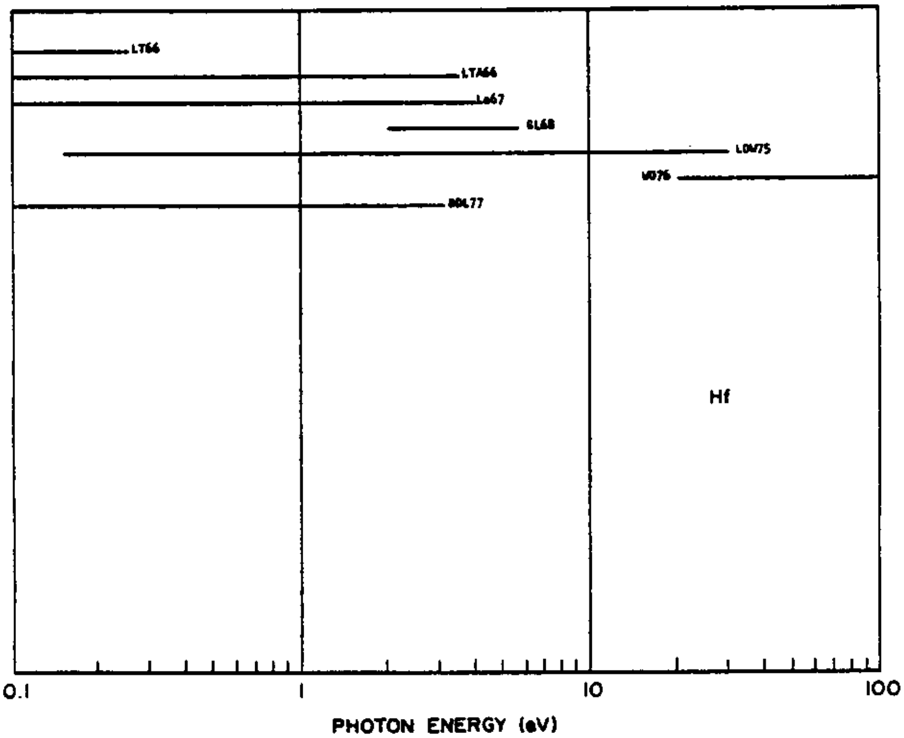

Fig. 68 Survey of available data for Hf

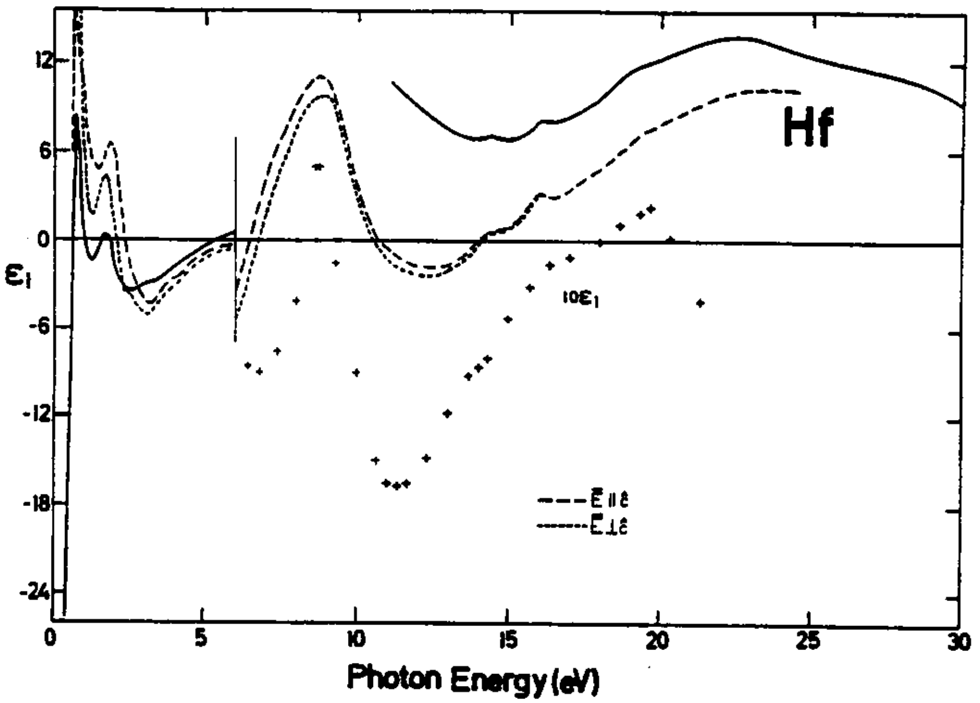

Fig. 70b ε_1 for Hf. Single crystal results (— — — for $\vec{E}\parallel\hat{c}$ and --- for $\vec{E}\perp\hat{c}$) by LOW (unpub) judged to be superior to earlier polycrystalline results (—— LOW75). +++ by LT75.

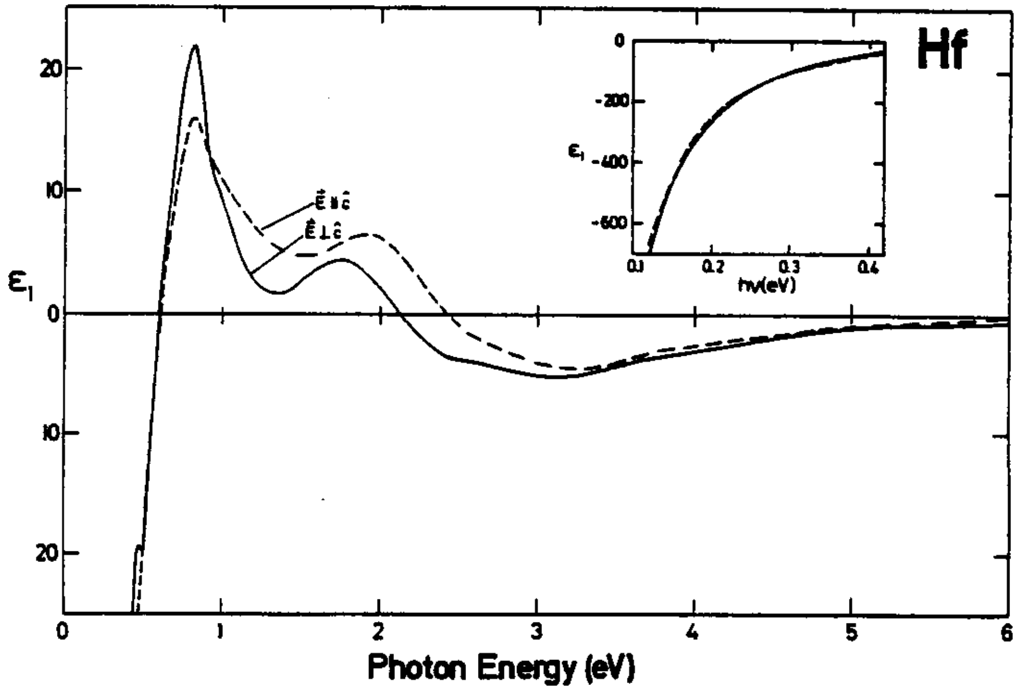

Fig. 70a ε_1 for Hf. Results for single crystal Hf by LOW (unpub) for $\vec{E}\parallel\hat{c}$ (---) and $\vec{E}\perp\hat{c}$ (——) judged by the authors to be superior to their earlier published polycrystalline data LOW75 (Fig 70b); single crystal results shown in tabulation for Hf.

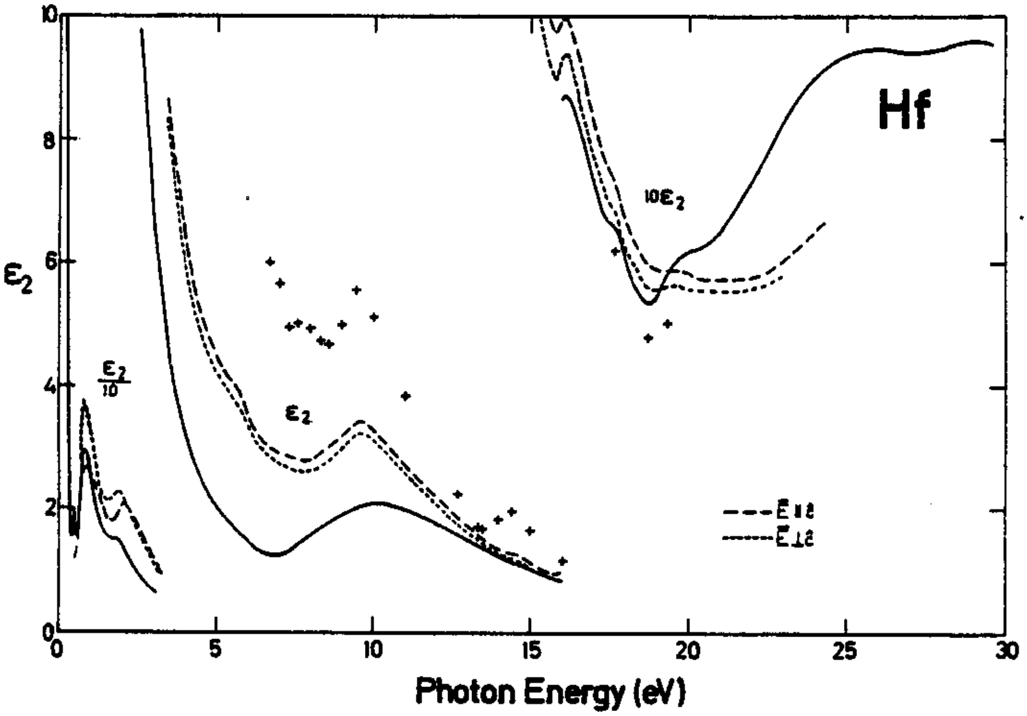

Fig. 71b ε_2 for Hf. Single crystal results (— — — for $\vec{E}\parallel\hat{c}$ and ---- for $\vec{E}\perp\hat{c}$) by LOW (unpub) judged to be superior to earlier polycrystalline results (—— LOW75). +++ by LT75.

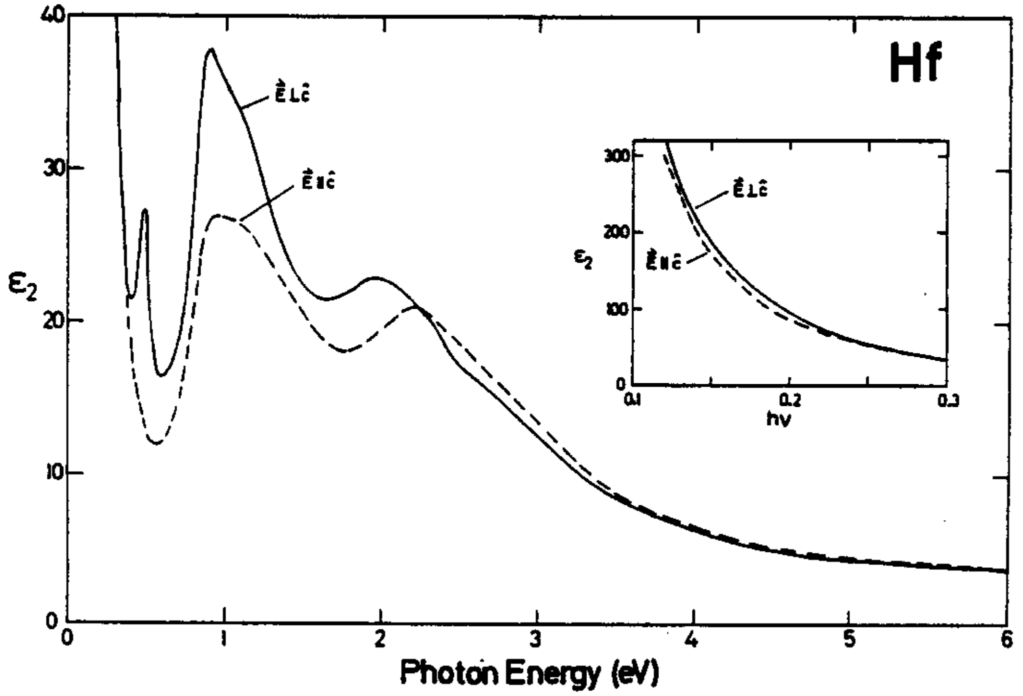

Fig. 71a ε_2 for Hf. Results for single crystal Hf by LOW (unpub) for $\vec{E}\parallel\hat{c}$ (---) and $\vec{E}\perp\hat{c}$ (——) judged by the authors to be superior to their earlier published polycrystalline data LOW75 (Fig 71b); single crystal results shown in tabulation for Hf.

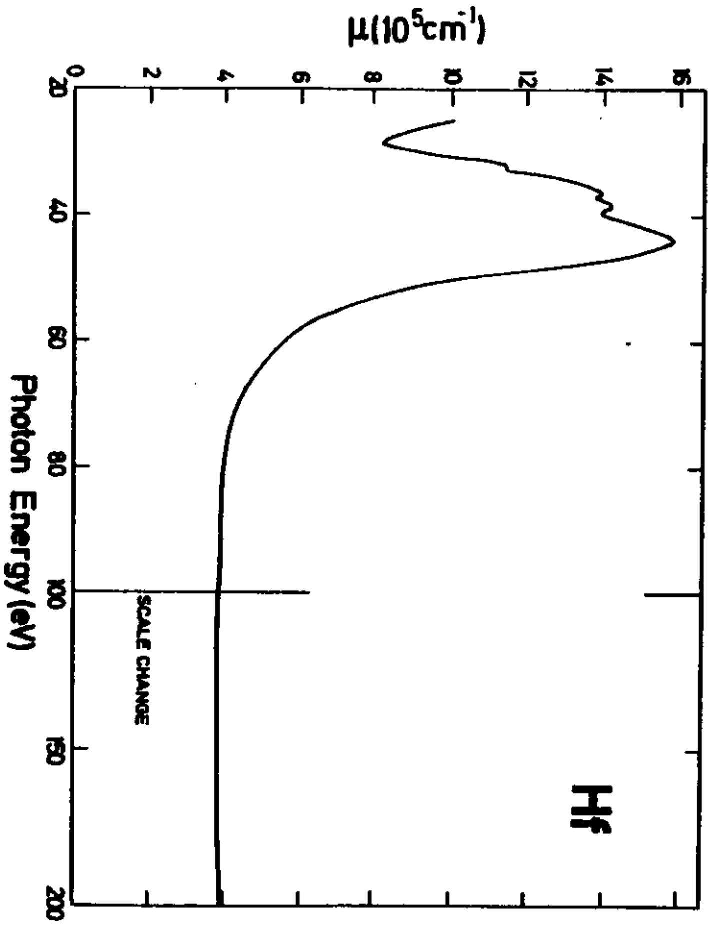

Fig. 72 Absorption coefficient for Hf reported by WO76.

Hafnium

single crystal with $\vec{E} \parallel \hat{c}$. These results by D.W. Lynch, C.G. Olson, and J.H. Weaver (unpub) supersede those of LOW75 [Phys. Rev. B 11, 3617 (1975)]

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε̃)	R(φ=0)
0.52	-14.71	12.17	1.48	4.11	0.03	.747
0.54	-10.80	12.08	1.64	3.67	0.05	.683
0.56	-7.43	12.06	1.84	3.29	0.06	.615
0.58	-4.23	12.12	2.07	2.92	0.07	.544
0.60	-1.37	12.25	2.34	2.62	0.08	.486
0.62	1.38	12.48	2.64	2.36	0.08	.445
0.64	3.71	13.08	2.94	2.22	0.07	.431
0.66	5.80	13.65	3.21	2.13	0.06	.428
0.68	7.74	14.27	3.46	2.06	0.05	.432
0.70	9.54	15.00	3.70	2.03	0.05	.441
0.72	11.22	15.83	3.91	2.02	0.04	.451
0.74	12.78	16.82	4.12	2.04	0.04	.463
0.76	14.17	18.06	4.31	2.10	0.03	.476
0.78	15.28	19.56	4.48	2.18	0.03	.490
0.80	15.94	21.30	4.61	2.31	0.03	.504
0.82	16.00	23.06	4.69	2.46	0.03	.517
0.84	15.54	24.45	4.72	2.59	0.03	.526
0.86	14.85	25.45	4.71	2.70	0.03	.533
0.88	14.13	26.06	4.68	2.79	0.03	.537
0.90	13.43	26.52	4.64	2.85	0.03	.541
0.93	12.59	26.79	4.59	2.92	0.03	.543
0.95	11.86	26.86	4.54	2.96	0.03	.545
0.98	11.28	26.79	4.49	2.98	0.03	.545
1.00	10.79	26.72	4.45	3.00	0.03	.545
1.02	10.35	26.65	4.41	3.02	0.03	.546
1.05	9.87	26.62	4.37	3.04	0.03	.546
1.08	9.38	26.51	4.33	3.06	0.03	.547
1.10	8.87	26.36	4.28	3.08	0.03	.547
1.15	7.91	25.89	4.18	3.10	0.04	.546
1.20	7.05	25.26	4.08	3.10	0.04	.544
1.25	6.28	24.51	3.97	3.08	0.04	.541
1.30	5.74	23.60	3.87	3.04	0.04	.536
1.35	5.38	22.75	3.79	3.00	0.04	.531
1.40	5.16	21.97	3.72	2.95	0.04	.525
1.45	4.95	21.29	3.66	2.91	0.04	.520
1.50	4.82	20.56	3.60	2.85	0.05	.514
1.55	4.80	19.85	3.55	2.79	0.05	.507
1.60	4.95	19.19	3.52	2.73	0.05	.500
1.65	5.23	18.67	3.51	2.66	0.05	.493
1.70	5.56	16.34	3.52	2.61	0.05	.488
1.75	5.90	18.20	3.54	2.57	0.05	.485
1.80	6.19	18.25	3.57	2.56	0.05	.485
1.85	6.39	18.44	3.60	2.56	0.05	.486
1.90	6.46	18.75	3.63	2.59	0.05	.489
1.95	6.37	19.14	3.64	2.63	0.05	.493
2.00	6.17	19.52	3.65	2.67	0.05	.499
2.05	5.84	19.96	3.65	2.73	0.05	.504
2.10	5.31	20.45	3.64	2.81	0.05	.511
2.15	4.53	20.87	3.60	2.90	0.05	.518

Hf $\vec{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im($-1/\tilde{\epsilon}$)	R(ϕ=0)
2.20	3.52	21.07	3.53	2.99	0.05	.526
2.25	2.50	20.92	3.43	3.05	0.05	.531
2.30	1.61	20.58	3.34	3.09	0.05	.534
2.35	0.85	20.12	3.24	3.11	0.05	.536
2.40	0.25	19.63	3.15	3.11	0.05	.537
2.45	-0.30	19.17	3.07	3.12	0.05	.538
2.50	-0.81	18.72	2.99	3.13	0.05	.540
2.55	-1.36	18.24	2.91	3.13	0.05	.542
2.60	-1.78	17.66	2.83	3.12	0.06	.542
2.65	-2.12	17.11	2.75	3.11	0.06	.542
2.70	-2.41	16.60	2.68	3.10	0.06	.542
2.75	-2.72	16.12	2.61	3.09	0.06	.543
2.80	-3.01	15.61	2.54	3.08	0.06	.543
2.85	-3.24	15.10	2.47	3.06	0.06	.543
2.90	-3.46	14.60	2.40	3.04	0.06	.544
2.95	-3.65	14.10	2.34	3.02	0.07	.544
3.00	-3.83	13.61	2.27	3.00	0.07	.544
3.05	-3.98	13.11	2.20	2.97	0.07	.544
3.10	-4.12	12.62	2.14	2.95	0.07	.544
3.15	-4.26	12.10	2.07	2.92	0.07	.544
3.20	-4.35	11.54	2.00	2.89	0.08	.544
3.25	-4.35	10.97	1.93	2.84	0.08	.542
3.30	-4.28	10.44	1.87	2.79	0.08	.538
3.35	-4.16	9.97	1.82	2.73	0.09	.534
3.40	-4.03	9.55	1.78	2.68	0.09	.528
3.45	-3.89	9.16	1.74	2.63	0.09	.523
3.50	-3.73	8.80	1.71	2.58	0.10	.517
3.55	-3.56	8.49	1.68	2.53	0.10	.510
3.60	-3.37	8.22	1.66	2.48	0.10	.503
3.65	-3.21	8.00	1.64	2.43	0.11	.496
3.70	-3.08	7.81	1.63	2.40	0.11	.491
3.75	-2.98	7.62	1.61	2.36	0.11	.486
3.80	-2.88	7.43	1.60	2.33	0.12	.481
3.85	-2.80	7.25	1.58	2.30	0.12	.477
3.90	-2.72	7.08	1.56	2.27	0.12	.473
3.95	-2.66	6.91	1.54	2.24	0.13	.469
4.00	-2.60	6.71	1.52	2.21	0.13	.466
4.05	-2.52	6.51	1.49	2.18	0.13	.461
4.10	-2.41	6.32	1.48	2.14	0.14	.455
4.15	-2.28	6.16	1.46	2.10	0.14	.448
4.20	-2.18	6.02	1.45	2.07	0.15	.442
4.25	-2.09	5.89	1.44	2.04	0.15	.437
4.30	-2.00	5.76	1.43	2.01	0.15	.431
4.35	-1.91	5.63	1.42	1.98	0.16	.426
4.40	-1.83	5.51	1.41	1.95	0.16	.420
4.45	-1.74	5.39	1.40	1.92	0.17	.414
4.50	-1.63	5.27	1.39	1.89	0.17	.407
4.55	-1.53	5.18	1.39	1.86	0.18	.400
4.60	-1.43	5.10	1.39	1.83	0.18	.394
4.65	-1.35	5.03	1.39	1.81	0.19	.388
4.70	-1.27	4.96	1.39	1.79	0.19	.382
4.75	-1.20	4.90	1.39	1.77	0.19	.377
4.80	-1.14	4.84	1.38	1.75	0.20	.373
4.85	-1.07	4.78	1.38	1.73	0.20	.368
4.90	-1.02	4.73	1.38	1.71	0.20	.364
4.95	-0.97	4.67	1.38	1.70	0.21	.360
5.00	-0.93	4.61	1.37	1.68	0.21	.356

Hf $\vec{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im($-1/\tilde{\epsilon}$)	R(ϕ=0)
5.05	-0.88	4.56	1.37	1.66	0.21	.352
5.10	-0.84	4.50	1.37	1.65	0.21	.348
5.15	-0.80	4.44	1.36	1.63	0.22	.345
5.20	-0.76	4.39	1.36	1.61	0.22	.341
5.25	-0.71	4.33	1.36	1.60	0.23	.336
5.30	-0.66	4.28	1.35	1.58	0.23	.332
5.35	-0.61	4.23	1.35	1.56	0.23	.328
5.40	-0.57	4.20	1.35	1.55	0.23	.324
5.45	-0.53	4.16	1.35	1.54	0.24	.321
5.50	-0.50	4.13	1.35	1.53	0.24	.319
5.55	-0.48	4.10	1.35	1.52	0.24	.316
5.60	-0.45	4.07	1.35	1.51	0.24	.314
5.65	-0.44	4.04	1.35	1.50	0.24	.312
5.70	-0.44	4.00	1.34	1.50	0.25	.311
5.75	-0.45	3.95	1.33	1.49	0.25	.310
5.80	-0.44	3.90	1.32	1.48	0.25	.308
5.85	-0.44	3.83	1.31	1.47	0.26	.306
5.90	-0.42	3.76	1.30	1.45	0.26	.303
5.95	-0.40	3.69	1.29	1.43	0.27	.299
6.00	-0.36	3.62	1.28	1.41	0.27	.295
6.05	-0.33	3.57	1.28	1.40	0.28	.291
6.10	-0.30	3.51	1.27	1.38	0.28	.287
6.15	-0.27	3.45	1.26	1.37	0.29	.283
6.20	-0.23	3.39	1.26	1.35	0.29	.278
6.25	-0.18	3.34	1.26	1.33	0.30	.273
6.30	-0.13	3.29	1.26	1.31	0.30	.267
6.35	-0.08	3.26	1.26	1.29	0.31	.263
6.40	-0.04	3.22	1.26	1.28	0.31	.258
6.45	-0.01	3.19	1.26	1.26	0.31	.254
6.50	0.03	3.15	1.26	1.25	0.32	.250
6.55	0.08	3.11	1.26	1.23	0.32	.245
6.60	0.12	3.08	1.27	1.22	0.32	.240
6.65	0.17	3.05	1.27	1.20	0.33	.236
6.70	0.21	3.03	1.27	1.19	0.33	.232
6.75	0.25	3.01	1.28	1.18	0.33	.228
6.80	0.29	2.99	1.28	1.16	0.33	.224
6.85	0.34	2.97	1.29	1.15	0.33	.220
6.90	0.38	2.95	1.30	1.14	0.33	.216
6.95	0.42	2.95	1.30	1.13	0.33	.214
7.00	0.45	2.95	1.31	1.13	0.33	.212
7.05	0.47	2.94	1.31	1.12	0.33	.210
7.10	0.50	2.93	1.32	1.11	0.33	.208
7.15	0.52	2.92	1.32	1.11	0.33	.206
7.20	0.55	2.91	1.33	1.10	0.33	.204
7.25	0.57	2.90	1.33	1.09	0.33	.202
7.30	0.60	2.89	1.33	1.09	0.33	.200
7.35	0.62	2.89	1.34	1.08	0.33	.198
7.40	0.65	2.88	1.34	1.07	0.33	.197
7.45	0.67	2.87	1.35	1.07	0.33	.195
7.50	0.69	2.87	1.35	1.06	0.33	.193
7.55	0.71	2.86	1.35	1.06	0.33	.192
7.60	0.73	2.86	1.36	1.05	0.33	.191
7.65	0.74	2.84	1.36	1.05	0.33	.189
7.70	0.77	2.83	1.36	1.04	0.33	.187
7.75	0.80	2.81	1.36	1.03	0.33	.185
7.80	0.83	2.81	1.37	1.02	0.33	.184
7.85	0.86	2.81	1.38	1.02	0.33	.182

Hf $\hat{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
7.90	0.89	2.81	1.39	1.01	0.32	.180
7.95	0.92	2.82	1.39	1.01	0.32	.179
8.00	0.94	2.83	1.40	1.01	0.32	.179
8.05	0.96	2.84	1.41	1.01	0.32	.178
8.10	0.99	2.85	1.41	1.01	0.31	.176
8.15	1.01	2.86	1.42	1.01	0.31	.178
8.20	1.02	2.87	1.43	1.01	0.31	.178
8.25	1.04	2.89	1.43	1.01	0.31	.178
8.30	1.05	2.90	1.44	1.01	0.30	.179
8.35	1.07	2.92	1.44	1.01	0.30	.179
8.40	1.08	2.94	1.45	1.01	0.30	.180
8.45	1.08	2.95	1.45	1.02	0.30	.181
8.50	1.09	2.97	1.46	1.02	0.30	.181
8.60	1.10	3.00	1.47	1.02	0.29	.183
8.70	1.11	3.04	1.47	1.03	0.29	.184
8.80	1.12	3.08	1.48	1.04	0.29	.186
8.90	1.11	3.13	1.49	1.05	0.28	.189
9.00	1.10	3.19	1.49	1.07	0.28	.193
9.10	1.07	3.24	1.50	1.08	0.28	.197
9.20	1.02	3.30	1.50	1.10	0.28	.201
9.30	0.97	3.34	1.49	1.12	0.28	.206
9.40	0.91	3.38	1.48	1.14	0.28	.211
9.50	0.83	3.42	1.47	1.16	0.28	.216
9.60	0.73	3.45	1.46	1.18	0.28	.222
9.70	0.62	3.44	1.43	1.20	0.28	.227
9.80	0.52	3.41	1.41	1.21	0.29	.230
9.90	0.44	3.37	1.38	1.22	0.29	.233
10.00	0.37	3.32	1.36	1.22	0.30	.235
10.10	0.30	3.28	1.34	1.22	0.30	.237
10.20	0.24	3.22	1.32	1.22	0.31	.238
10.30	0.19	3.17	1.30	1.22	0.31	.240
10.40	0.14	3.11	1.28	1.22	0.32	.240
10.50	0.10	3.05	1.25	1.22	0.33	.241
10.60	0.06	2.99	1.24	1.21	0.33	.241
10.70	0.03	2.93	1.22	1.21	0.34	.242
10.80	0.00	2.88	1.20	1.20	0.35	.242
10.90	-0.03	2.82	1.18	1.19	0.35	.242
11.00	-0.05	2.76	1.16	1.19	0.36	.242
11.10	-0.07	2.71	1.15	1.18	0.37	.241
11.20	-0.09	2.66	1.13	1.17	0.38	.241
11.30	-0.11	2.60	1.12	1.16	0.38	.241
11.40	-0.13	2.55	1.10	1.16	0.39	.241
11.40	-0.13	2.55	1.10	1.16	0.39	.241
11.50	-0.14	2.49	1.09	1.15	0.40	.240
11.60	-0.15	2.44	1.07	1.14	0.41	.239
11.70	-0.16	2.39	1.06	1.13	0.42	.238
11.80	-0.17	2.34	1.04	1.12	0.43	.238
11.90	-0.17	2.29	1.03	1.11	0.43	.237
12.00	-0.18	2.24	1.02	1.10	0.44	.236
12.10	-0.18	2.19	1.00	1.09	0.45	.235
12.20	-0.19	2.14	0.99	1.08	0.46	.234
12.30	-0.19	2.09	0.98	1.07	0.47	.233
12.40	-0.19	2.04	0.96	1.06	0.49	.232
12.50	-0.19	2.00	0.95	1.05	0.50	.230
12.60	-0.18	1.95	0.94	1.04	0.51	.229
12.70	-0.18	1.91	0.93	1.02	0.52	.227
12.80	-0.18	1.86	0.92	1.01	0.53	.225

Hf $\hat{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
12.90	-0.17	1.82	0.91	1.00	0.54	.224
13.00	-0.17	1.78	0.90	0.99	0.56	.222
13.10	-0.16	1.73	0.89	0.98	0.57	.220
13.20	-0.16	1.69	0.88	0.96	0.59	.218
13.30	-0.15	1.64	0.87	0.95	0.61	.216
13.40	-0.13	1.60	0.86	0.93	0.62	.212
13.50	-0.12	1.55	0.85	0.92	0.64	.209
13.60	-0.10	1.51	0.84	0.90	0.66	.205
13.70	-0.08	1.48	0.84	0.88	0.68	.201
13.80	-0.06	1.44	0.83	0.87	0.69	.196
13.90	-0.04	1.41	0.83	0.85	0.71	.191
14.00	-0.01	1.38	0.83	0.83	0.73	.186
14.10	0.02	1.36	0.83	0.82	0.74	.180
14.20	0.05	1.34	0.83	0.81	0.74	.175
14.30	0.06	1.34	0.84	0.80	0.75	.172
14.40	0.06	1.33	0.83	0.80	0.75	.172
14.50	0.06	1.31	0.83	0.79	0.76	.171
14.60	0.06	1.28	0.82	0.78	0.78	.170
14.70	0.06	1.26	0.81	0.77	0.79	.169
14.80	0.07	1.22	0.81	0.76	0.81	.167
14.90	0.08	1.19	0.80	0.75	0.84	.164
15.00	0.10	1.16	0.79	0.73	0.85	.160
15.10	0.11	1.13	0.79	0.72	0.87	.157
15.20	0.13	1.11	0.79	0.70	0.89	.153
15.30	0.14	1.08	0.78	0.69	0.91	.148
15.40	0.16	1.05	0.78	0.67	0.93	.143
15.50	0.19	1.03	0.78	0.65	0.94	.138
15.60	0.21	1.00	0.79	0.64	0.96	.132
15.70	0.25	0.98	0.79	0.62	0.96	.124
15.80	0.29	0.98	0.81	0.61	0.94	.117
15.90	0.31	0.99	0.82	0.60	0.92	.112
16.00	0.32	1.00	0.83	0.60	0.90	.111
16.10	0.32	1.01	0.83	0.61	0.90	.112
16.20	0.31	1.00	0.83	0.61	0.91	.114
16.30	0.30	0.99	0.82	0.61	0.92	.115
16.40	0.30	0.97	0.81	0.60	0.94	.114
16.50	0.30	0.95	0.80	0.59	0.96	.113
16.60	0.30	0.92	0.80	0.58	0.98	.111
16.70	0.31	0.90	0.79	0.57	1.00	.108
16.80	0.32	0.88	0.79	0.55	1.01	.105
16.90	0.33	0.85	0.79	0.54	1.02	.102
17.00	0.34	0.83	0.79	0.53	1.03	.098
17.10	0.36	0.81	0.79	0.51	1.03	.094
17.20	0.38	0.79	0.79	0.50	1.03	.089
17.30	0.39	0.78	0.80	0.49	1.02	.086
17.40	0.41	0.77	0.80	0.48	1.02	.083
17.50	0.42	0.76	0.80	0.47	1.01	.080
17.60	0.43	0.74	0.80	0.46	1.00	.077
17.70	0.44	0.73	0.80	0.45	1.00	.075
17.80	0.45	0.71	0.80	0.44	1.00	.072
17.90	0.47	0.69	0.81	0.43	0.99	.068
18.00	0.49	0.68	0.81	0.42	0.98	.064
18.20	0.52	0.65	0.82	0.39	0.93	.057
18.40	0.56	0.63	0.84	0.38	0.89	.051
18.60	0.60	0.61	0.85	0.36	0.83	.045
18.80	0.64	0.60	0.87	0.34	0.78	.040
19.00	0.68	0.59	0.89	0.33	0.73	.036

HF $\vec{E}\parallel\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
19.20	0.71	0.59	0.90	0.33	0.70	.033
19.40	0.73	0.59	0.92	0.32	0.67	.031
19.60	0.76	0.59	0.93	0.32	0.64	.030
19.80	0.78	0.59	0.94	0.31	0.62	.028
20.00	0.80	0.59	0.94	0.31	0.60	.027
20.20	0.82	0.58	0.95	0.30	0.58	.026
20.40	0.84	0.58	0.96	0.30	0.56	.024
20.60	0.86	0.57	0.97	0.30	0.54	.023
20.80	0.88	0.58	0.98	0.29	0.52	.023
21.00	0.90	0.57	0.99	0.29	0.51	.022
21.20	0.91	0.57	1.00	0.29	0.49	.022
21.40	0.93	0.57	1.01	0.28	0.48	.021
21.60	0.95	0.57	1.01	0.28	0.47	.020
21.80	0.97	0.58	1.02	0.28	0.45	.020
22.00	0.98	0.58	1.03	0.28	0.44	.020
22.20	1.00	0.58	1.04	0.28	0.43	.020
22.40	1.02	0.58	1.05	0.28	0.42	.020
22.60	1.04	0.59	1.06	0.28	0.42	.020
22.80	1.05	0.60	1.06	0.28	0.41	.021
23.00	1.06	0.61	1.07	0.28	0.41	.021
23.20	1.07	0.61	1.07	0.29	0.40	.021
23.40	1.08	0.62	1.08	0.29	0.40	.022
23.60	1.09	0.64	1.09	0.29	0.40	.022
23.80	1.10	0.65	1.09	0.30	0.40	.023
24.00	1.10	0.65	1.09	0.30	0.40	.023
24.20	1.11	0.66	1.10	0.30	0.39	.023
24.40	1.12	0.67	1.10	0.30	0.39	.024
24.60	1.12	0.67	1.10	0.31	0.39	.024
24.80	1.13	0.68	1.11	0.31	0.39	.025

Hafnium

single crystal with $\vec{E}\perp\hat{c}$. These results by D.W. Lynch, C.G. Olson, and J.H. Weaver (unpub) supercede those of LOW75 [Phys. Rev. B <u>11</u>, 3617 (1975)]

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
0.51	-18.31	22.74	2.33	4.87	0.03	.735
0.52	-16.52	20.96	2.25	4.65	0.03	.723
0.53	-14.49	19.46	2.21	4.40	0.03	.705
0.54	-12.18	18.35	2.22	4.14	0.04	.680
0.56	-7.93	17.14	2.34	3.66	0.05	.623
0.58	-3.76	16.52	2.57	3.22	0.06	.559
0.60	-0.25	16.40	2.84	2.89	0.06	.512
0.62	2.99	16.49	3.14	2.62	0.06	.482
0.64	5.70	17.05	3.44	2.48	0.05	.473
0.66	8.23	17.40	3.71	2.35	0.05	.469
0.68	10.76	17.94	3.98	2.25	0.04	.473
0.70	13.22	18.84	4.26	2.21	0.04	.482
0.72	15.47	20.08	4.52	2.22	0.03	.495
0.74	17.45	21.53	4.75	2.27	0.03	.508
0.76	19.25	23.18	4.97	2.33	0.03	.521
0.78	21.02	25.15	5.19	2.42	0.02	.535
0.80	22.35	28.33	5.41	2.62	0.02	.554
0.82	22.33	31.78	5.53	2.87	0.02	.570
0.84	20.81	35.06	5.55	3.16	0.02	.585
0.86	18.51	36.73	5.46	3.36	0.02	.593
0.88	16.20	37.72	5.35	3.53	0.02	.599
0.90	14.12	37.79	5.22	3.62	0.02	.601
0.93	12.14	37.42	5.07	3.69	0.02	.603
0.95	10.69	36.81	4.95	3.72	0.03	.602
0.98	9.58	36.26	4.85	3.74	0.03	.602
1.00	8.57	35.79	4.76	3.76	0.03	.602
1.02	7.66	35.25	4.68	3.77	0.03	.602
1.05	6.81	34.71	4.59	3.78	0.03	.601
1.08	6.01	34.17	4.51	3.79	0.03	.601
1.10	5.18	33.60	4.43	3.80	0.03	.601
1.15	3.66	32.17	4.24	3.79	0.03	.599
1.20	2.54	30.41	4.07	3.74	0.03	.594
1.25	1.96	28.58	3.91	3.65	0.03	.587
1.30	1.78	26.96	3.79	3.55	0.04	.578
1.35	1.70	25.61	3.70	3.46	0.04	.570
1.40	1.77	24.29	3.61	3.36	0.04	.561
1.45	2.20	23.08	3.56	3.24	0.04	.550
1.50	2.78	22.25	3.55	3.13	0.04	.540
1.55	3.36	21.78	3.56	3.06	0.04	.532
1.60	3.75	21.61	3.58	3.01	0.04	.529
1.65	4.08	21.50	3.60	2.98	0.04	.526
1.70	4.29	21.59	3.63	2.98	0.04	.526
1.75	4.36	21.79	3.65	2.99	0.04	.527
1.80	4.25	22.11	3.66	3.02	0.04	.530
1.85	3.92	22.47	3.66	3.07	0.04	.535
1.90	3.31	22.81	3.63	3.14	0.04	.541
1.95	2.55	22.92	3.58	3.20	0.04	.546
2.00	1.71	22.86	3.51	3.26	0.04	.551
2.05	0.91	22.61	3.43	3.30	0.04	.555

Hf $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε̃)	R(ϕ=0)
2.10	0.15	22.27	3.35	3.33	0.04	.558
2.15	-0.56	21.85	3.26	3.35	0.05	.560
2.20	-1.22	21.37	3.18	3.36	0.05	.563
2.25	-1.85	20.86	3.09	3.38	0.05	.565
2.30	-2.51	20.27	2.99	3.39	0.05	.568
2.35	-3.10	19.52	2.89	3.38	0.05	.569
2.40	-3.50	18.66	2.78	3.35	0.05	.569
2.45	-3.59	17.84	2.70	3.30	0.05	.565
2.50	-3.62	17.25	2.65	3.26	0.06	.562
2.55	-3.72	16.79	2.60	3.23	0.06	.560
2.60	-3.91	16.33	2.54	3.22	0.06	.560
2.65	-4.07	15.83	2.48	3.20	0.06	.560
2.70	-4.20	15.35	2.42	3.17	0.06	.559
2.75	-4.33	14.88	2.36	3.15	0.06	.559
2.80	-4.45	14.42	2.31	3.13	0.06	.558
2.85	-4.53	13.98	2.25	3.10	0.06	.558
2.90	-4.64	13.58	2.20	3.08	0.07	.558
2.95	-4.80	13.15	2.14	3.07	0.07	.559
3.00	-4.97	12.66	2.08	3.05	0.07	.561
3.05	-5.06	12.12	2.01	3.02	0.07	.561
3.10	-5.08	11.58	1.94	2.98	0.07	.560
3.15	-5.05	11.05	1.88	2.93	0.07	.558
3.20	-4.97	10.56	1.83	2.88	0.08	.555
3.25	-4.85	10.11	1.78	2.83	0.08	.552
3.30	-4.70	9.71	1.74	2.78	0.08	.547
3.35	-4.55	9.36	1.71	2.73	0.09	.542
3.40	-4.42	9.04	1.68	2.69	0.09	.538
3.45	-4.29	8.74	1.65	2.65	0.09	.533
3.50	-4.16	8.45	1.62	2.61	0.10	.529
3.55	-4.03	8.19	1.60	2.56	0.10	.524
3.60	-3.90	7.95	1.57	2.52	0.10	.519
3.65	-3.78	7.72	1.55	2.49	0.10	.515
3.70	-3.67	7.50	1.53	2.45	0.11	.510
3.75	-3.56	7.29	1.51	2.42	0.11	.506
3.80	-3.46	7.10	1.49	2.38	0.11	.501
3.85	-3.35	6.91	1.47	2.35	0.12	.497
3.90	-3.26	6.72	1.45	2.32	0.12	.493
3.95	-3.17	6.54	1.43	2.28	0.12	.489
4.00	-3.08	6.36	1.41	2.25	0.13	.484
4.05	-2.98	6.18	1.39	2.22	0.13	.480
4.10	-2.86	6.01	1.38	2.18	0.14	.474
4.15	-2.75	5.85	1.36	2.15	0.14	.468
4.20	-2.64	5.72	1.35	2.11	0.14	.462
4.25	-2.55	5.59	1.34	2.08	0.15	.457
4.30	-2.45	5.45	1.33	2.05	0.15	.451
4.35	-2.34	5.32	1.32	2.02	0.16	.445
4.40	-2.23	5.21	1.31	1.99	0.16	.438
4.45	-2.13	5.12	1.31	1.96	0.17	.432
4.50	-2.05	5.02	1.30	1.93	0.17	.427
4.55	-1.96	4.92	1.29	1.91	0.18	.421
4.60	-1.87	4.83	1.29	1.88	0.18	.415
4.65	-1.78	4.74	1.28	1.85	0.18	.408
4.70	-1.69	4.66	1.28	1.82	0.19	.402
4.75	-1.60	4.56	1.28	1.80	0.19	.395
4.80	-1.51	4.52	1.28	1.77	0.20	.389
4.85	-1.44	4.47	1.28	1.75	0.20	.384
4.90	-1.38	4.41	1.27	1.73	0.21	.379

Hf $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε̃)	R(ϕ=0)
4.95	-1.30	4.35	1.27	1.71	0.21	.373
5.00	-1.23	4.30	1.27	1.69	0.21	.367
5.05	-1.17	4.26	1.27	1.67	0.22	.363
5.10	-1.12	4.21	1.27	1.65	0.22	.358
5.15	-1.07	4.16	1.27	1.64	0.23	.354
5.20	-1.01	4.12	1.27	1.62	0.23	.349
5.25	-0.96	4.08	1.27	1.61	0.23	.345
5.30	-0.91	4.05	1.27	1.59	0.23	.341
5.35	-0.88	4.02	1.27	1.58	0.24	.338
5.40	-0.85	3.98	1.27	1.57	0.24	.335
5.45	-0.83	3.94	1.26	1.56	0.24	.333
5.50	-0.79	3.89	1.26	1.54	0.25	.329
5.55	-0.75	3.85	1.26	1.53	0.25	.325
5.60	-0.72	3.82	1.26	1.52	0.25	.322
5.65	-0.70	3.79	1.26	1.51	0.26	.320
5.70	-0.69	3.75	1.25	1.50	0.26	.318
5.75	-0.67	3.71	1.25	1.49	0.26	.315
5.80	-0.65	3.67	1.24	1.48	0.26	.313
5.85	-0.64	3.62	1.23	1.47	0.27	.311
5.90	-0.63	3.56	1.22	1.46	0.27	.309
5.95	-0.60	3.50	1.21	1.44	0.28	.306
6.00	-0.57	3.44	1.21	1.42	0.28	.302
6.05	-0.54	3.38	1.20	1.41	0.29	.298
6.10	-0.51	3.33	1.20	1.39	0.29	.294
6.15	-0.47	3.28	1.19	1.38	0.30	.290
6.20	-0.43	3.23	1.19	1.36	0.30	.285
6.25	-0.40	3.18	1.18	1.34	0.31	.280
6.30	-0.36	3.13	1.18	1.32	0.32	.275
6.35	-0.31	3.08	1.18	1.31	0.32	.270
6.40	-0.26	3.04	1.18	1.29	0.33	.265
6.45	-0.22	3.01	1.18	1.27	0.33	.260
6.50	-0.17	2.97	1.18	1.25	0.34	.254
6.55	-0.12	2.94	1.19	1.24	0.34	.249
6.60	-0.07	2.92	1.19	1.22	0.34	.244
6.65	-0.03	2.91	1.20	1.21	0.34	.241
6.70	0.01	2.89	1.20	1.20	0.35	.237
6.75	0.04	2.87	1.21	1.19	0.35	.233
6.80	0.07	2.86	1.21	1.18	0.35	.230
6.85	0.10	2.84	1.21	1.17	0.35	.227
6.90	0.13	2.82	1.21	1.16	0.35	.224
6.95	0.16	2.80	1.22	1.15	0.36	.221
7.00	0.20	2.78	1.22	1.14	0.36	.217
7.05	0.23	2.77	1.23	1.13	0.36	.214
7.10	0.26	2.75	1.23	1.12	0.36	.211
7.15	0.28	2.74	1.23	1.11	0.36	.209
7.20	0.31	2.72	1.23	1.10	0.36	.206
7.25	0.34	2.70	1.24	1.09	0.36	.203
7.30	0.38	2.68	1.24	1.08	0.37	.199
7.35	0.42	2.68	1.25	1.07	0.36	.196
7.40	0.45	2.67	1.26	1.06	0.36	.194
7.45	0.48	2.67	1.26	1.06	0.36	.192
7.50	0.51	2.67	1.27	1.05	0.36	.190
7.55	0.53	2.67	1.27	1.05	0.36	.189
7.60	0.55	2.67	1.28	1.04	0.36	.187
7.65	0.57	2.66	1.28	1.04	0.36	.185
7.70	0.59	2.65	1.29	1.03	0.36	.183
7.75	0.62	2.64	1.29	1.02	0.36	.192

Hf $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
7.80	0.65	2.64	1.30	1.02	0.36	.180
7.85	0.68	2.63	1.30	1.01	0.36	.178
7.90	0.71	2.63	1.31	1.00	0.35	.176
7.95	0.74	2.64	1.32	1.00	0.35	.175
8.00	0.77	2.65	1.33	1.00	0.35	.174
8.10	0.80	2.67	1.34	1.00	0.34	.173
8.20	0.84	2.69	1.35	0.99	0.34	.173
8.30	0.88	2.71	1.36	0.99	0.33	.172
8.40	0.90	2.74	1.38	0.99	0.33	.173
8.50	0.93	2.77	1.39	1.00	0.32	.173
8.60	0.95	2.80	1.40	1.00	0.32	.174
8.70	0.97	2.84	1.41	1.01	0.32	.176
8.80	0.98	2.88	1.42	1.02	0.31	.178
8.90	0.98	2.93	1.43	1.03	0.31	.181
9.00	0.98	2.98	1.43	1.04	0.30	.184
9.10	0.97	3.04	1.44	1.06	0.30	.188
9.20	0.93	3.11	1.45	1.08	0.30	.193
9.30	0.87	3.17	1.44	1.10	0.29	.199
9.40	0.79	3.21	1.43	1.12	0.29	.204
9.50	0.71	3.24	1.42	1.14	0.29	.209
9.60	0.63	3.25	1.40	1.16	0.30	.214
9.70	0.55	3.26	1.39	1.17	0.30	.218
9.80	0.46	3.25	1.37	1.19	0.30	.223
9.90	0.36	3.23	1.34	1.20	0.31	.227
10.00	0.28	3.18	1.32	1.21	0.31	.230
10.10	0.21	3.12	1.29	1.21	0.32	.232
10.20	0.15	3.07	1.27	1.21	0.33	.234
10.30	0.10	3.01	1.25	1.21	0.33	.235
10.40	0.06	2.96	1.23	1.20	0.34	.235
10.50	0.02	2.90	1.21	1.20	0.34	.236
10.60	-0.02	2.84	1.19	1.20	0.35	.237
10.70	-0.05	2.79	1.17	1.19	0.36	.237
10.80	-0.08	2.73	1.15	1.19	0.37	.237
10.90	-0.10	2.68	1.13	1.18	0.37	.238
11.00	-0.13	2.62	1.12	1.17	0.38	.237
11.10	-0.14	2.56	1.10	1.16	0.39	.237
11.20	-0.16	2.51	1.08	1.16	0.40	.237
11.30	-0.18	2.46	1.07	1.15	0.41	.236
11.40	-0.19	2.40	1.05	1.14	0.41	.236
11.50	-0.20	2.35	1.04	1.13	0.42	.235
11.60	-0.21	2.30	1.03	1.12	0.43	.235
11.70	-0.22	2.25	1.01	1.11	0.44	.234
11.80	-0.22	2.20	1.00	1.10	0.45	.233
11.90	-0.23	2.15	0.98	1.09	0.46	.232
11.90	-0.23	2.15	0.98	1.09	0.46	.232
12.00	-0.23	2.10	0.97	1.08	0.47	.231
12.10	-0.24	2.05	0.96	1.07	0.48	.230
12.20	-0.24	2.01	0.94	1.06	0.49	.229
12.30	-0.24	1.96	0.93	1.05	0.50	.228
12.40	-0.23	1.91	0.92	1.04	0.52	.226
12.50	-0.23	1.87	0.91	1.03	0.53	.225
12.60	-0.23	1.82	0.90	1.02	0.54	.223
12.70	-0.22	1.78	0.89	1.00	0.55	.221
12.80	-0.21	1.74	0.86	0.99	0.57	.219
12.90	-0.21	1.69	0.87	0.98	0.58	.217
13.00	-0.20	1.65	0.66	0.97	0.60	.215
13.10	-0.19	1.61	0.85	0.95	0.61	.213

Hf $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
13.20	-0.19	1.57	0.83	0.94	0.63	.211
13.30	-0.18	1.52	0.82	0.92	0.65	.208
13.40	-0.16	1.48	0.82	0.91	0.67	.205
13.50	-0.14	1.44	0.81	0.89	0.69	.201
13.60	-0.12	1.40	0.80	0.88	0.71	.196
13.70	-0.10	1.37	0.80	0.86	0.73	.192
13.80	-0.08	1.34	0.79	0.84	0.75	.188
13.90	-0.06	1.30	0.79	0.83	0.77	.183
14.00	-0.03	1.27	0.79	0.81	0.79	.177
14.10	0.00	1.25	0.79	0.79	0.80	.170
14.20	0.02	1.24	0.79	0.78	0.81	.165
14.30	0.04	1.23	0.80	0.77	0.81	.162
14.40	0.05	1.22	0.80	0.77	0.82	.160
14.50	0.05	1.21	0.79	0.76	0.83	.160
14.60	0.05	1.19	0.79	0.75	0.84	.159
14.70	0.06	1.16	0.78	0.74	0.86	.157
14.80	0.06	1.13	0.77	0.73	0.88	.154
14.90	0.08	1.10	0.77	0.72	0.90	.150
15.00	0.09	1.08	0.77	0.70	0.92	.147
15.10	0.10	1.05	0.76	0.69	0.94	.144
15.20	0.11	1.03	0.76	0.68	0.96	.140
15.30	0.13	1.00	0.76	0.66	0.98	.135
15.40	0.15	0.98	0.76	0.65	1.00	.130
15.50	0.17	0.95	0.76	0.63	1.02	.125
15.60	0.20	0.93	0.76	0.61	1.03	.119
15.70	0.23	0.91	0.77	0.59	1.03	.112
15.80	0.27	0.90	0.78	0.58	1.01	.104
15.90	0.30	0.91	0.80	0.57	0.99	.099
16.00	0.31	0.93	0.81	0.58	0.96	.099
16.10	0.31	0.94	0.81	0.59	0.96	.101
16.20	0.29	0.94	0.80	0.59	0.97	.103
16.30	0.28	0.92	0.79	0.58	0.99	.104
16.40	0.28	0.90	0.78	0.57	1.01	.102
16.50	0.29	0.87	0.78	0.56	1.03	.100
16.60	0.29	0.85	0.77	0.55	1.05	.097
16.70	0.30	0.83	0.77	0.54	1.06	.095
16.80	0.31	0.81	0.77	0.53	1.07	.092
16.90	0.32	0.79	0.77	0.52	1.08	.089
17.00	0.34	0.77	0.77	0.50	1.09	.085
17.10	0.35	0.75	0.77	0.49	1.09	.081
17.20	0.37	0.74	0.77	0.48	1.08	.077
17.30	0.39	0.73	0.78	0.47	1.07	.073
17.40	0.40	0.72	0.78	0.46	1.06	.071
17.50	0.41	0.70	0.78	0.45	1.06	.068
17.60	0.42	0.69	0.79	0.44	1.05	.065
17.70	0.43	0.68	0.79	0.43	1.05	.063
17.80	0.45	0.66	0.79	0.42	1.04	.060
17.90	0.46	0.64	0.79	0.41	1.03	.057
18.00	0.48	0.63	0.80	0.39	1.01	.053
18.10	0.50	0.61	0.60	0.38	0.98	.050
18.20	0.52	0.61	0.81	0.37	0.95	.047
18.30	0.54	0.60	0.82	0.36	0.93	.044
18.40	0.55	0.59	0.82	0.36	0.90	.041
18.50	0.57	0.58	0.83	0.35	0.87	.039
18.60	0.59	0.57	0.84	0.34	0.84	.036
18.70	0.61	0.57	0.85	0.33	0.81	.034
18.80	0.63	0.56	0.86	0.33	0.79	.032

Hf $\vec{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
18.90	0.65	0.56	0.87	0.32	0.76	.031
19.00	0.67	0.56	0.88	0.32	0.74	.030
19.20	0.70	0.56	0.89	0.32	0.70	.028
19.40	0.72	0.57	0.90	0.31	0.68	.027
19.60	0.74	0.56	0.91	0.31	0.65	.025
19.80	0.76	0.56	0.92	0.30	0.63	.024
20.00	0.78	0.56	0.93	0.30	0.61	.023
20.20	0.80	0.56	0.94	0.30	0.59	.023
20.40	0.82	0.56	0.95	0.29	0.57	.022
20.60	0.83	0.56	0.96	0.29	0.55	.021
20.80	0.85	0.56	0.97	0.29	0.54	.021
21.00	0.87	0.56	0.97	0.29	0.53	.020
21.20	0.88	0.56	0.98	0.28	0.51	.020
21.40	0.90	0.55	0.99	0.28	0.50	.019
21.60	0.92	0.56	1.00	0.28	0.48	.019
21.80	0.93	0.56	1.00	0.28	0.47	.019
22.00	0.95	0.56	1.01	0.28	0.46	.019
22.20	0.96	0.56	1.02	0.28	0.45	.018
22.40	0.98	0.56	1.03	0.27	0.44	.018
22.60	0.99	0.57	1.03	0.27	0.43	.018
22.80	1.01	0.57	1.04	0.28	0.43	.019
23.00	1.02	0.58	1.05	0.28	0.42	.019
23.20	1.03	0.59	1.05	0.28	0.42	.019
23.40	1.04	0.60	1.06	0.28	0.41	.020
23.60	1.05	0.60	1.06	0.28	0.41	.020
23.80	1.06	0.61	1.07	0.29	0.41	.021
24.00	1.07	0.62	1.07	0.29	0.41	.021
24.20	1.08	0.62	1.08	0.29	0.40	.021
24.40	1.09	0.63	1.08	0.29	0.40	.022
24.60	1.09	0.64	1.09	0.30	0.40	.022
24.80	1.10	0.65	1.09	0.30	0.40	.023

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample: Film	Sample: X-tal	Sample: Bulk	Sample: Prep	Data Presentation	Remarks Ta
LFJ64	7.1-23.6	Refl				x	Heat	R	heated in situ ~10^{-9} Torr
AU66	~2.5-55	Refl	~2000			x		Im(ε^{-1})	energy loss spectroscopy at several temperatures
Ba66	0.6-2.6	Ellips				x	Ex	n,k	filaments at various T
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
Le67	0.1-4					x	MP	ε_2/λ	data from LT66 and LTA66
LTA66	0.1-3.5					x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
JCF68	~78-~506	m-θ		x			Ex	μ/ρ	soft x-ray absorption with synchrotron radiation
JLM68	2.1-23.1					x	Heat	R,n,k,ε_1,ε_2,Im(ε^{-1})	heated ~2600 K at ~10^{-9} Torr
HRS69	30-600	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
BB74			1200-2600			x		ε_N at λ = 6450 Å	
WL074	0.1-35	Refl	4.2 for hν < 4.88 eV RT for hν > 4.88 eV			x	EP	A,R; KK: ε_1,ε_2, Im(ε^{-1}),Im(ε+1)$^{-1}$	absorptivity measured by calorimetry for hν < 4.88 eV, reflectivity for hν > 4.88 eV with synchrotron radiation, see also RCF80
Zho74			>1000					ε	emissivity
KNN75	0.07-4.09	Ellips			x		EP	n,k,ε_1,σ	(110) crystal

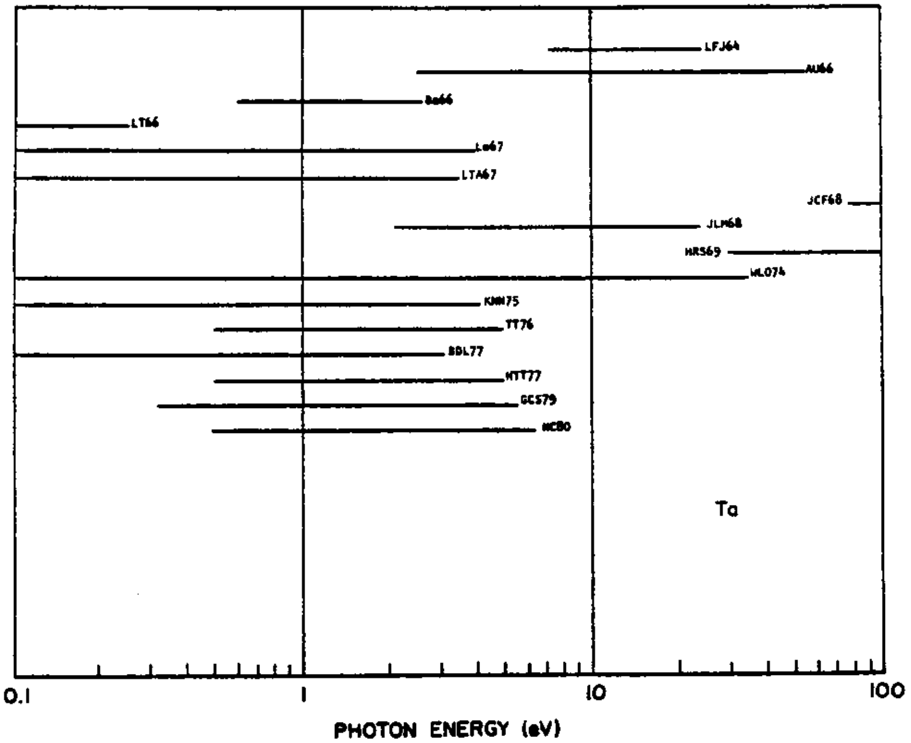

Fig. 73 Survey of available data for Ta

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Ta
				Film	X-tal	Bulk	Prep		
TT76	0.5-5	Ellips	4.2			x	In	ε_2 (interband)	heated to 2000 K in uhv
BDL77	0.03-3.1	Refl				x		R	also emissivity 400-850 K
HTT77	0.5-5	Ellips	4.2-1100			x	In	ε_2 (interband)	heated to 2000 K in uhv
GCS79	0.32-5.6	Trans, Refl		x			In	σ	uhv evaporation
NC80	0.5-6.5	Trans, Refl		x			Ex	n,k,σ	polycrystalline thin films, substrate T: 1275-1425 K

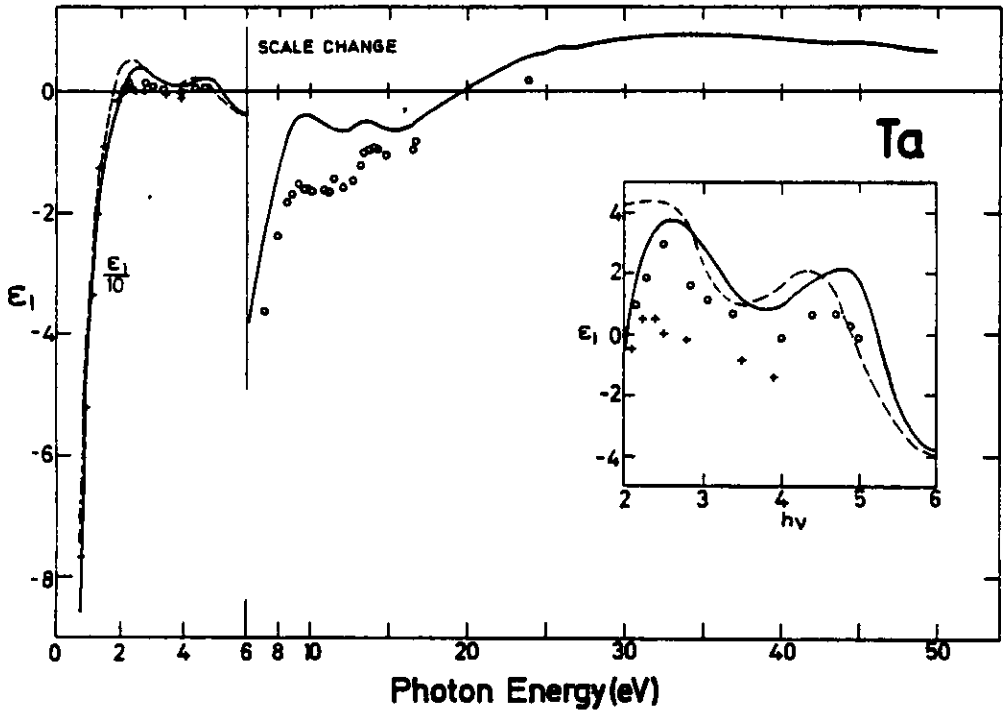

Fig. 75 ε_1 for Ta. —— WL074; +++ KNN75; --- NC80; ooo JLM68.

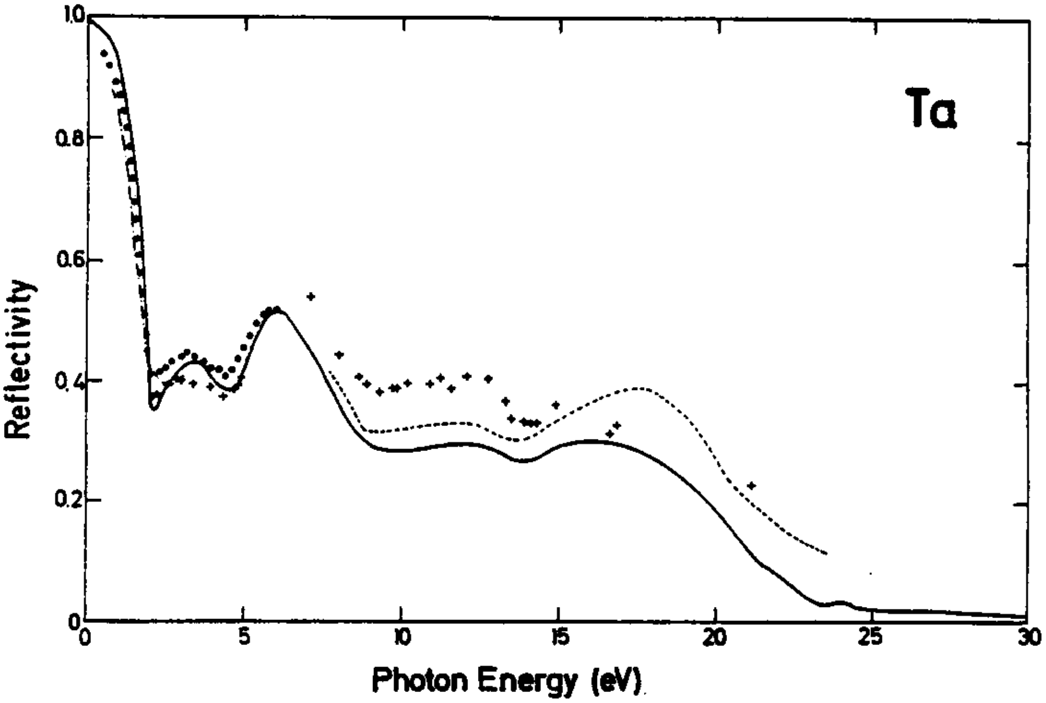

Fig. 74 Reflectivity of Ta. —— WL074; ••• NC80; +++ JLM68; -·- BDL77; --- LFJ64.

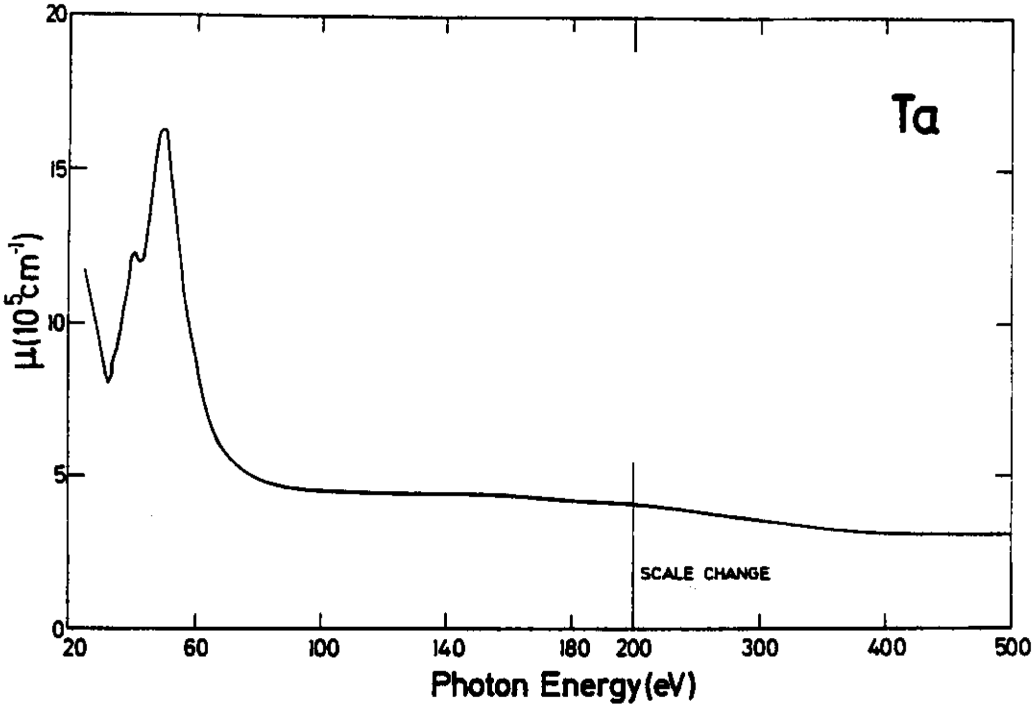

Fig. 77 Absorption coefficient for Ta reported by HRS69.

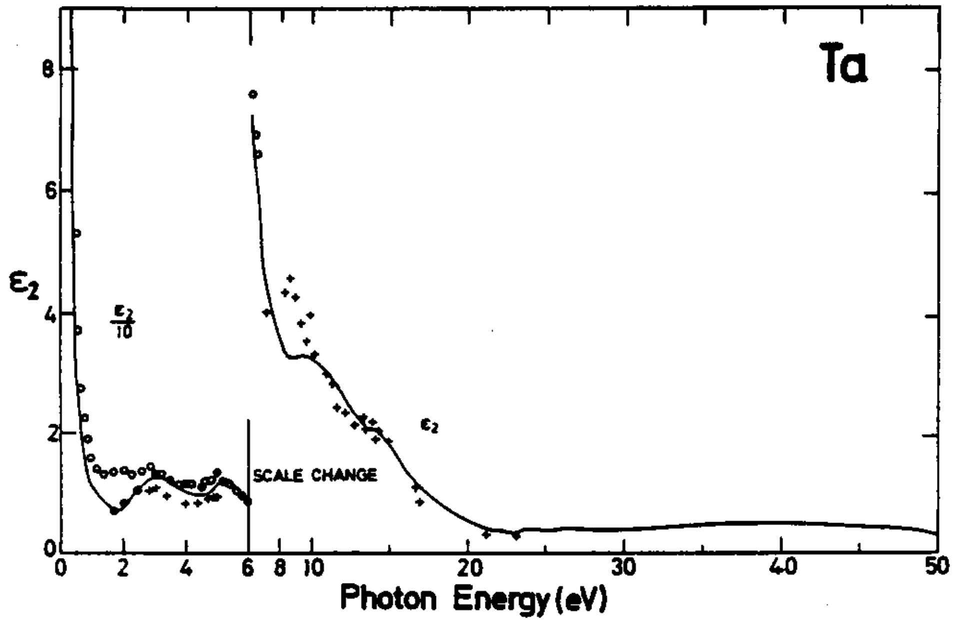

Fig. 76 ϵ_2 for Ta. —— WLO74; +++ JLM68· ooo NC80; ••• TT76.

Tantalum

publication by J.H. Weaver, D.W. Lynch, and C.G. Olson in Phys. Rev. B 10, 501 (1973) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε̃)	R(ϕ=0)
0.10	-4042.00	2541.28	19.14	66.39	0.00	.981
0.11	-3484.86	1997.03	16.30	61.24	0.00	.984
0.12	-3033.13	1589.75	13.99	56.82	0.00	.984
0.13	-2652.67	1281.37	12.11	52.91	0.00	.984
0.14	-2331.18	1052.56	10.64	49.44	0.00	.984
0.15	-2064.25	876.90	9.45	46.41	0.00	.983
0.16	-1839.62	739.07	8.45	43.72	0.00	.983
0.18	-1486.15	540.87	6.91	39.16	0.00	.983
0.19	-1345.69	468.56	6.29	37.22	0.00	.983
0.20	-1224.20	409.07	5.77	35.46	0.00	.982
0.22	-1024.82	315.70	4.88	32.38	0.00	.982
0.24	-868.36	250.07	4.20	29.77	0.00	.982
0.26	-744.69	201.89	3.67	27.53	0.00	.981
0.28	-644.99	165.52	3.23	25.60	0.00	.981
0.30	-562.87	137.29	2.87	23.90	0.00	.980
0.34	-438.95	101.03	2.40	21.09	0.00	.979
0.38	-352.12	76.56	2.03	18.87	0.00	.978
0.42	-288.01	59.89	1.75	17.06	0.00	.976
0.46	-239.37	47.86	1.54	15.55	0.00	.975
0.50	-201.46	39.20	1.37	14.26	0.00	.974
0.54	-171.42	32.78	1.25	13.15	0.00	.972
0.58	-147.30	28.03	1.15	12.19	0.00	.970
0.62	-127.59	24.14	1.06	11.35	0.00	.968
0.66	-111.17	21.23	1.00	10.59	0.00	.965
0.70	-97.52	19.03	0.96	9.92	0.00	.962
0.74	-86.05	17.10	0.92	9.32	0.00	.960
0.78	-76.20	15.55	0.89	8.77	0.00	.956
0.82	-67.71	14.29	0.86	8.27	0.00	.952
0.86	-60.32	13.22	0.85	7.81	0.00	.947
0.90	-53.76	12.38	0.84	7.38	0.00	.942
0.94	-48.06	12.05	0.86	6.99	0.00	.934
0.98	-43.29	11.69	0.88	6.64	0.01	.926
1.00	-41.11	11.48	0.89	6.47	0.01	.922
1.10	-32.19	10.68	0.93	5.75	0.01	.899
1.20	-25.51	10.04	0.98	5.14	0.01	.872
1.30	-20.36	9.27	1.00	4.62	0.02	.842
1.40	-16.15	8.67	1.04	4.15	0.03	.805
1.50	-12.71	8.09	1.09	3.73	0.04	.762
1.60	-9.75	7.64	1.15	3.33	0.05	.707
1.70	-7.20	7.30	1.24	2.95	0.07	.640
1.80	-4.92	6.99	1.35	2.60	0.10	.560
1.90	-2.56	7.01	1.57	2.24	0.13	.460
2.00	-0.61	7.26	1.83	1.99	0.14	.384
2.10	1.03	7.74	2.10	1.84	0.13	.354
2.20	2.30	8.53	2.36	1.81	0.11	.351
2.30	3.10	9.51	2.56	1.86	0.10	.365
2.40	3.46	10.31	2.68	1.92	0.09	.378
2.50	3.63	10.87	2.75	1.98	0.08	.388
2.60	3.78	11.30	2.80	2.02	0.08	.395
2.70	3.73	11.84	2.84	2.08	0.08	.405
2.80	3.54	12.20	2.85	2.14	0.08	.412
2.90	3.22	12.49	2.84	2.20	0.08	.420
3.00	2.86	12.60	2.81	2.24	0.08	.425
3.20	2.12	12.56	2.73	2.31	0.08	.432
3.40	1.37	12.18	2.61	2.33	0.08	.435
3.60	0.89	11.44	2.49	2.30	0.09	.430
3.80	0.84	10.67	2.40	2.22	0.09	.418
4.00	0.95	10.11	2.36	2.14	0.10	.406
4.20	1.27	9.69	2.35	2.06	0.10	.392
4.40	1.67	9.58	2.39	2.01	0.10	.384
4.60	2.00	9.81	2.45	2.00	0.10	.384
4.80	2.13	10.40	2.53	2.06	0.09	.394
5.00	1.77	11.35	2.58	2.20	0.09	.416
5.20	0.39	12.25	2.52	2.44	0.08	.450
5.40	-1.46	12.08	2.31	2.61	0.08	.480
5.60	-2.91	10.99	2.06	2.67	0.09	.501
5.80	-3.58	9.62	1.83	2.63	0.09	.510
6.00	-3.87	8.36	1.63	2.56	0.10	.515
6.20	-3.80	7.26	1.48	2.45	0.11	.512
6.40	-3.55	6.39	1.37	2.33	0.12	.504
6.60	-3.25	5.71	1.29	2.22	0.13	.492
6.80	-2.94	5.18	1.23	2.11	0.15	.478
7.00	-2.63	4.76	1.18	2.01	0.16	.462
7.20	-2.34	4.40	1.15	1.91	0.18	.445
7.40	-2.05	4.13	1.13	1.82	0.19	.425
7.60	-1.79	3.92	1.12	1.75	0.21	.406
7.80	-1.59	3.73	1.11	1.68	0.23	.390
8.00	-1.36	3.57	1.11	1.61	0.24	.370
8.20	-1.14	3.45	1.12	1.55	0.26	.350
8.40	-0.96	3.38	1.13	1.50	0.27	.332
8.60	-0.79	3.32	1.14	1.45	0.29	.317
8.80	-0.62	3.30	1.17	1.41	0.29	.301
9.00	-0.53	3.33	1.19	1.40	0.29	.294
9.20	-0.46	3.34	1.21	1.38	0.29	.289
9.40	-0.44	3.35	1.21	1.38	0.29	.287
9.60	-0.42	3.34	1.21	1.38	0.29	.285
9.80	-0.42	3.32	1.21	1.37	0.30	.285
10.00	-0.44	3.30	1.20	1.37	0.30	.286
10.20	-0.45	3.27	1.19	1.37	0.30	.286
10.40	-0.47	3.22	1.18	1.37	0.30	.287
10.60	-0.50	3.18	1.16	1.36	0.31	.288
10.80	-0.52	3.12	1.15	1.36	0.31	.289
11.00	-0.55	3.06	1.13	1.35	0.32	.290
11.20	-0.58	3.00	1.11	1.35	0.32	.292
11.40	-0.61	2.93	1.09	1.34	0.33	.293
11.60	-0.64	2.85	1.07	1.33	0.33	.294
11.80	-0.66	2.77	1.05	1.32	0.34	.295
12.00	-0.68	2.68	1.02	1.31	0.35	.296
12.20	-0.66	2.59	1.00	1.29	0.36	.295
12.40	-0.68	2.50	0.98	1.28	0.37	.294
12.60	-0.66	2.41	0.96	1.26	0.39	.292
12.80	-0.64	2.34	0.94	1.24	0.40	.289
13.00	-0.62	2.27	0.93	1.22	0.41	.285
13.20	-0.59	2.20	0.92	1.20	0.42	.282
13.40	-0.55	2.15	0.91	1.18	0.44	.276
13.60	-0.52	2.12	0.91	1.16	0.44	.272

Ta

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
13.80	-0.51	2.10	0.91	1.16	0.45	.270
14.00	-0.52	2.08	0.90	1.15	0.45	.272
14.20	-0.55	2.05	0.89	1.15	0.46	.275
14.40	-0.58	2.00	0.87	1.15	0.46	.280
14.60	-0.61	1.95	0.85	1.15	0.47	.285
14.80	-0.63	1.88	0.82	1.14	0.48	.289
15.00	-0.65	1.80	0.80	1.13	0.49	.293
15.20	-0.66	1.73	0.77	1.12	0.51	.297
15.40	-0.66	1.64	0.75	1.10	0.52	.300
15.60	-0.65	1.57	0.72	1.08	0.54	.301
15.80	-0.64	1.49	0.70	1.06	0.57	.303
16.00	-0.62	1.42	0.68	1.04	0.59	.304
16.20	-0.60	1.35	0.66	1.02	0.62	.304
16.40	-0.57	1.28	0.64	0.99	0.65	.302
16.60	-0.55	1.22	0.63	0.97	0.68	.301
16.80	-0.52	1.16	0.61	0.94	0.72	.299
17.00	-0.49	1.10	0.60	0.92	0.76	.296
17.20	-0.46	1.05	0.58	0.89	0.80	.293
17.40	-0.42	1.00	0.57	0.87	0.85	.289
17.60	-0.39	0.95	0.56	0.84	0.90	.285
17.80	-0.36	0.90	0.56	0.81	0.96	.280
18.00	-0.32	0.86	0.55	0.79	1.02	.274
18.20	-0.29	0.82	0.54	0.76	1.08	.268
18.40	-0.25	0.79	0.54	0.73	1.15	.261
18.60	-0.22	0.75	0.53	0.71	1.23	.254
18.80	-0.18	0.72	0.53	0.68	1.31	.245
19.00	-0.15	0.69	0.53	0.65	1.39	.236
19.20	-0.12	0.66	0.52	0.63	1.48	.227
19.40	-0.08	0.63	0.53	0.60	1.56	.217
19.60	-0.05	0.60	0.53	0.57	1.64	.207
19.80	-0.02	0.58	0.53	0.55	1.72	.196
20.00	0.02	0.56	0.54	0.52	1.79	.185
20.20	0.05	0.54	0.54	0.50	1.85	.175
20.40	0.07	0.51	0.55	0.47	1.91	.165
20.60	0.11	0.49	0.55	0.44	1.95	.153
20.80	0.14	0.47	0.56	0.42	1.95	.140
21.00	0.17	0.45	0.57	0.39	1.92	.127
21.20	0.22	0.44	0.59	0.37	1.84	.113
21.40	0.25	0.43	0.61	0.35	1.72	.100
21.60	0.29	0.44	0.64	0.34	1.59	.089
21.80	0.29	0.43	0.64	0.34	1.59	.088
22.00	0.31	0.41	0.64	0.32	1.54	.081
22.20	0.34	0.40	0.66	0.30	1.44	.072
22.40	0.37	0.39	0.68	0.29	1.34	.065
22.60	0.40	0.37	0.69	0.27	1.24	.058
22.80	0.44	0.36	0.71	0.26	1.13	.051
23.00	0.48	0.36	0.73	0.24	1.01	.043
23.20	0.52	0.37	0.76	0.24	0.90	.036
23.40	0.56	0.39	0.79	0.25	0.85	.033
23.50	0.56	0.40	0.79	0.25	0.84	.033
23.60	0.57	0.42	0.80	0.26	0.84	.033
23.70	0.56	0.43	0.80	0.27	0.85	.034
23.80	0.56	0.43	0.80	0.27	0.86	.035
23.90	0.56	0.42	0.79	0.27	0.86	.034
24.00	0.56	0.42	0.80	0.26	0.85	.034
24.20	0.58	0.41	0.80	0.26	0.82	.032
24.40	0.59	0.41	0.81	0.25	0.79	.030

Ta

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
24.60	0.61	0.41	0.82	0.25	0.76	.029
24.80	0.62	0.41	0.83	0.25	0.74	.027
25.00	0.63	0.41	0.83	0.25	0.72	.026
25.20	0.65	0.41	0.84	0.25	0.70	.025
25.40	0.66	0.41	0.85	0.24	0.68	.023
25.60	0.68	0.42	0.86	0.24	0.65	.022
25.80	0.70	0.43	0.87	0.25	0.64	.022
26.00	0.70	0.44	0.88	0.25	0.64	.022
26.20	0.70	0.45	0.88	0.26	0.65	.023
26.40	0.69	0.45	0.87	0.26	0.66	.023
26.60	0.69	0.45	0.87	0.26	0.66	.023
26.80	0.69	0.44	0.87	0.25	0.65	.023
27.00	0.70	0.43	0.87	0.25	0.64	.022
27.20	0.71	0.42	0.88	0.24	0.62	.021
27.40	0.72	0.41	0.88	0.24	0.60	.020
27.60	0.73	0.41	0.89	0.23	0.58	.019
27.80	0.74	0.41	0.89	0.23	0.57	.018
28.00	0.75	0.41	0.90	0.23	0.56	.017
28.20	0.76	0.41	0.90	0.22	0.54	.016
28.40	0.78	0.41	0.91	0.22	0.53	.016
28.60	0.79	0.41	0.91	0.22	0.52	.015
28.80	0.80	0.41	0.92	0.22	0.51	.015
29.00	0.81	0.41	0.92	0.22	0.50	.014
29.20	0.82	0.41	0.93	0.22	0.49	.014
29.40	0.83	0.41	0.94	0.22	0.48	.014
29.60	0.84	0.41	0.94	0.22	0.48	.014
29.80	0.85	0.42	0.95	0.22	0.47	.014
30.00	0.85	0.42	0.95	0.22	0.47	.014
30.50	0.87	0.44	0.96	0.23	0.46	.014
31.00	0.88	0.45	0.97	0.23	0.46	.014
31.50	0.89	0.46	0.97	0.24	0.46	.014
32.00	0.89	0.47	0.98	0.24	0.46	.015
32.50	0.90	0.48	0.98	0.24	0.46	.015
33.00	0.90	0.48	0.98	0.25	0.46	.015
33.50	0.91	0.49	0.98	0.25	0.46	.015
34.00	0.91	0.50	0.99	0.25	0.46	.016
34.50	0.91	0.51	0.99	0.26	0.47	.016
35.00	0.91	0.52	0.99	0.26	0.47	.017
35.50	0.91	0.53	0.99	0.27	0.48	.018
36.00	0.90	0.53	0.99	0.27	0.49	.018
36.50	0.90	0.54	0.99	0.27	0.49	.019
37.00	0.89	0.55	0.99	0.28	0.50	.019
37.50	0.88	0.55	0.98	0.28	0.51	.020
38.00	0.87	0.56	0.98	0.28	0.52	.021
38.50	0.86	0.56	0.97	0.29	0.53	.021
39.00	0.85	0.56	0.97	0.29	0.54	.022
39.50	0.84	0.56	0.96	0.29	0.55	.022
40.00	0.82	0.56	0.95	0.29	0.56	.023

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks W
				Film	X-tal	Bulk	Prep		
Vuj70								ε	emissivity
CM71	1.9-3.18	Ellips			x		Heat	$n,k,\varepsilon_1,\varepsilon_2$	table λ,n,k; heat 2200-2600 K; LEED characterization
Hu71	6.2-41.3	Refl		x			Ex	R	
NKN71	0.06-4.9	Ellips			x		EP	$n,k,\sigma,A,\varepsilon_1,\varepsilon_2$	
UKK71	1-12	Refl			x		Heat	R; KK: $\varepsilon_1,\varepsilon_2$	~1700 K in situ
CHR72	6.2-41.3	Refl		x			Ex	R	substrate T: 313-773 K, plotted data for T = 313 K, transmission = 15.3%, and film thickness = 120 Å
LCS72	0.25-4.13		1200-2600			x		ε_N	emissivity
NKN72	0.3-4.1	Ellips	77		x		EP	n,k,σ	
Rod72	1.13-1.77		1700-2300					ε	emissivity
Sm72	1.96, 2.27	Ellips	~280-2100		x		In	n,k	sputter-anneal; characterize with AES
Aks74	0.12-1.24		373-773					ε_N	emissivity
Zho74			>1000					ε	emissivity

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks W
				Film	X-tal	Bulk	Prep		
Rob59	0.47-3.4	Ellips	RT,1100,1600			x	EP	$n,k,\varepsilon_1,\varepsilon_2$	
LFJ64	7.1-23.6	Refl				x	Heat	R	heated in situ ~10^{-9} Torr
TSV65	2.66-17.6		1800, 2150 2520			x	Heat	n,k	thermal emission, plotted data is at T = 1800 K
AU66	~2.5-55	Refl	~2000			x	Heat	$\mathrm{Im}(\varepsilon^{-1})$	energy loss spectroscopy
Ba66	0.6-2.6	Ellips	300-2400			x	Heat	n,k	sample: cross-section filaments at various T
LP66	0.16-2.5	Ellips				x	MP	n,k,A	mechanically polished sinter samples
LT66	0.06-0.25	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\varepsilon_2/\lambda,\varepsilon_1$	
Le67	0.1-4	Ellips				x	MP	ε_2/λ	data from LT66 and LTA66
JLM68	2.1-23.1	m-θ				x	Heat	$R,n,k,\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	heat ~2800 K at ~10^{-9} Torr
CM69	2-3.26	Ellips			x		In	n,k	heated 2200 K; LEED characterization (110)
HRS69	30-600	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
Kon69								ε	emissivity
LCS70	0.31-3.1		1200-2600			x		ε	emissivity

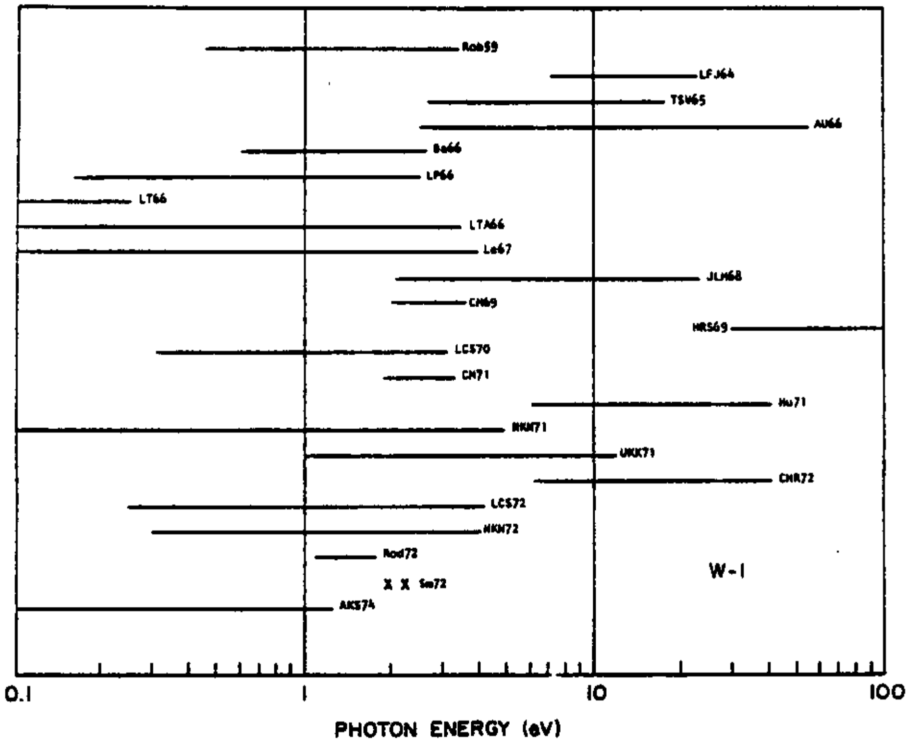

Fig. 78 Survey of available data for W

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		W
WOL75	0.15-33	Refl	4.2 K ≤ 4.4 eV 300 K > 4.4 eV			x	EP	R,A; KK: $\varepsilon_1,\varepsilon_2$, $\mathrm{Im}(\varepsilon^{-1}),\mathrm{Im}(\varepsilon+1)^{-1}$	absorptivity measured by calorimetry for $h\nu < 4.4$ eV, reflectivity measured for $h\nu > 4$ eV with synchrotron radiaton
HR76	0.25-3.1		<3300					ε	emissivity
TT76	0.5-5	Ellips	4.2			x	Heat	ε_2	heat ~2000 K in uhv
WO76	20-250	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
HTT77	0.5-5	Ellips	4.2-1100	x			Heat	$\varepsilon_2,\varepsilon_N$	also emissivity; heat to ~2000 K in situ
GS77			773	x				ε	emissivity
GCS79	0.32-5.6	Trans, Refl		x			In	σ	evaporation in situ in uhv
NC80	0.5-6.5	Trans, Refl				x	Ex	n,k,σ	polycrystalline thin films, substrate T: 1423-1273 K
NCC80	0.5-6.5	Trans, Refl		x			Ex	σ	examined dependence of R on substrate temperature
WSG80			340-1260		x			ε_H	calorimetric; emissivity

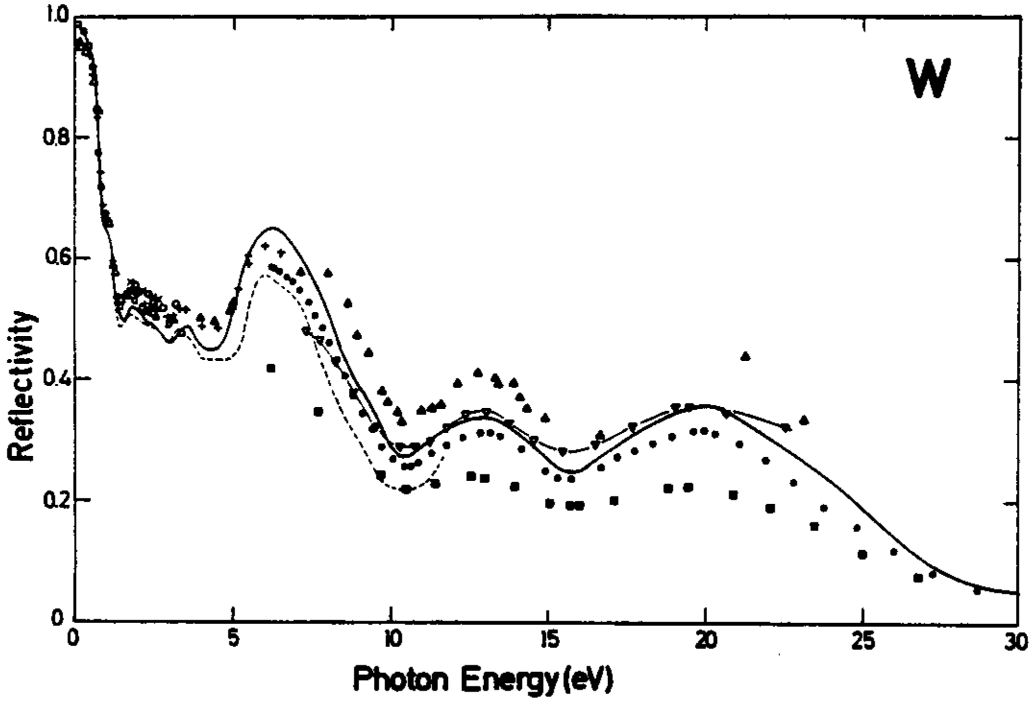

Fig. 79 Reflectivity of W. —— WL075; xxx TSV65; +++ NC80; --- UKK71; ooo CM71; ■■■ CHR72; ▲▲▲ JLM68; ΔΔΔ LP66; □□□ NKN71; ●●● Hu71; ▽▽▽ LFJ64.

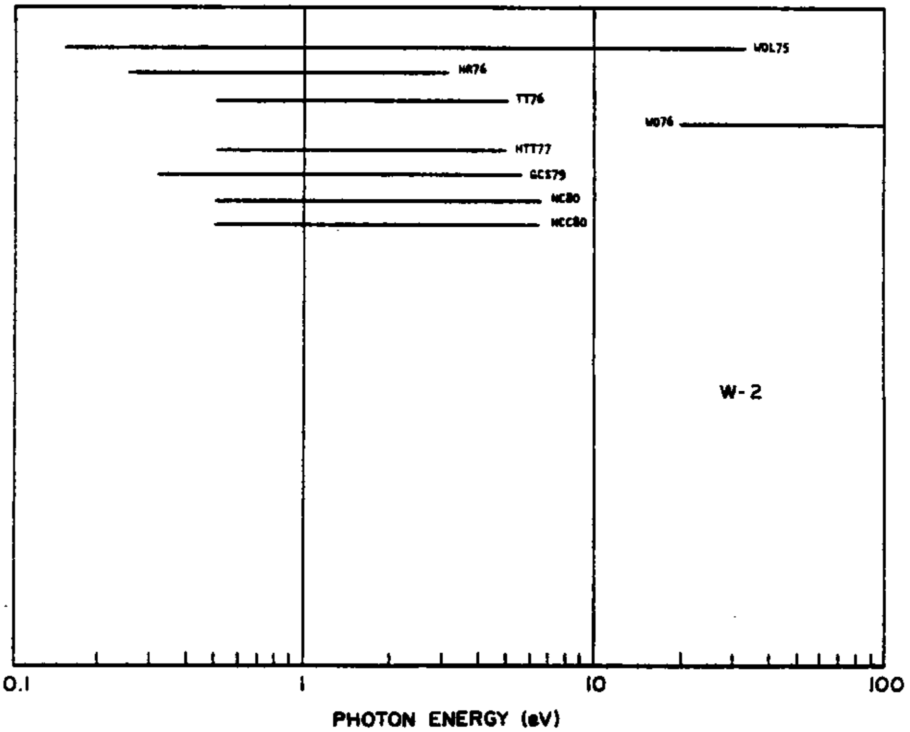

Fig. 78 Survey of available data for W

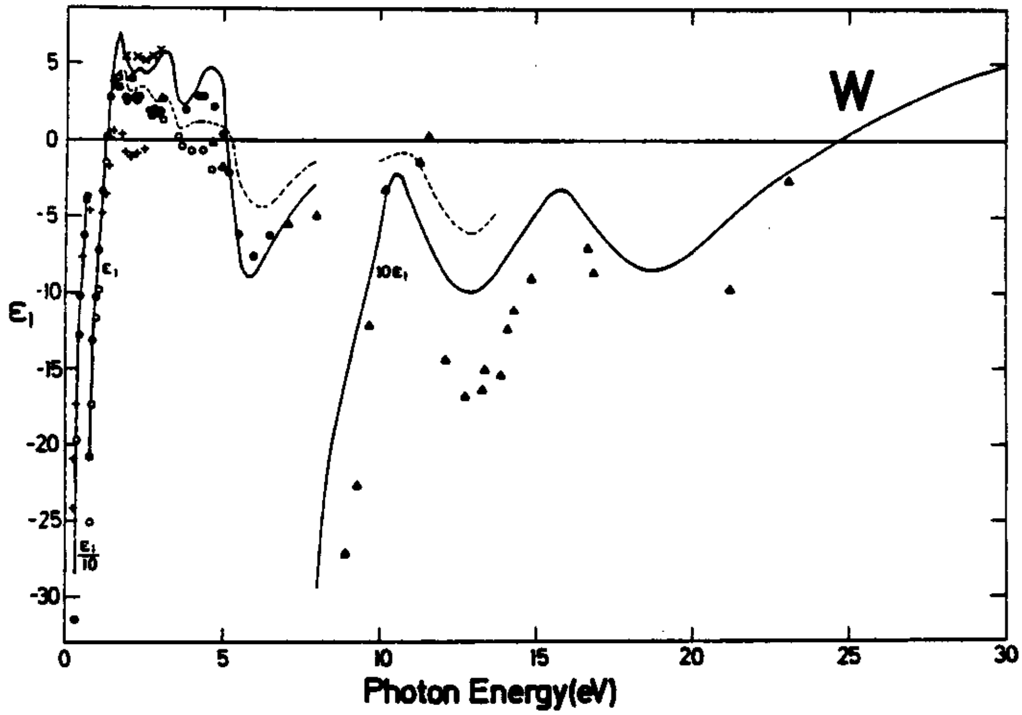

Fig. 81 ε_1 for W. —— WL075; --- UKK71; ●●● NC80; xxx CH71; ▲▲▲ JLM68; +++ LP66; ○○○ NKN71.

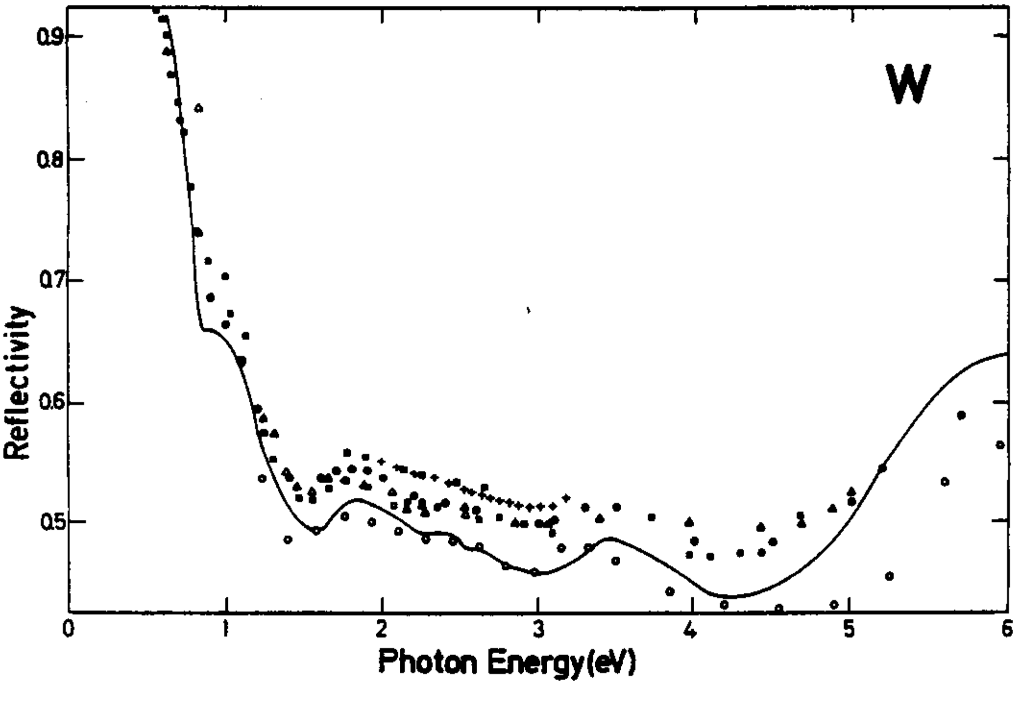

Fig. 80 Reflectivity of W for $0 \leq h\nu \leq 6$ eV. —— WL075; □□□ NKN71; ΔΔΔ LP66; ▲▲▲ JLM72; +++ CM71; ●●● NC80; ○○○ UKK71; ■■■ TSV65.

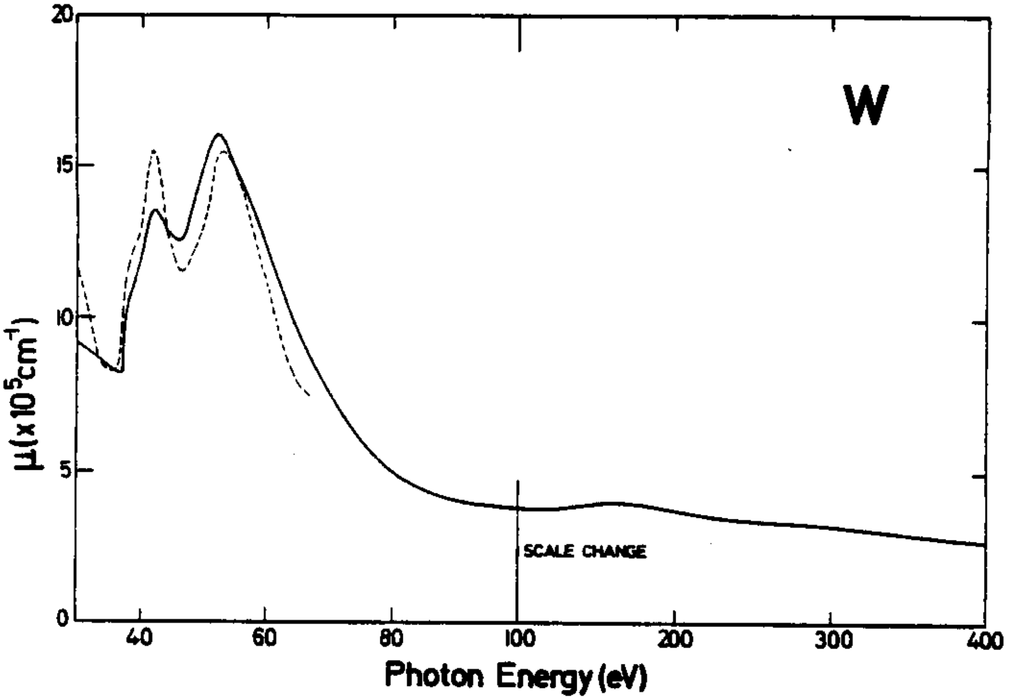

Fig. 83 Absorption coefficient for W. —— HRS69; --- WO76.

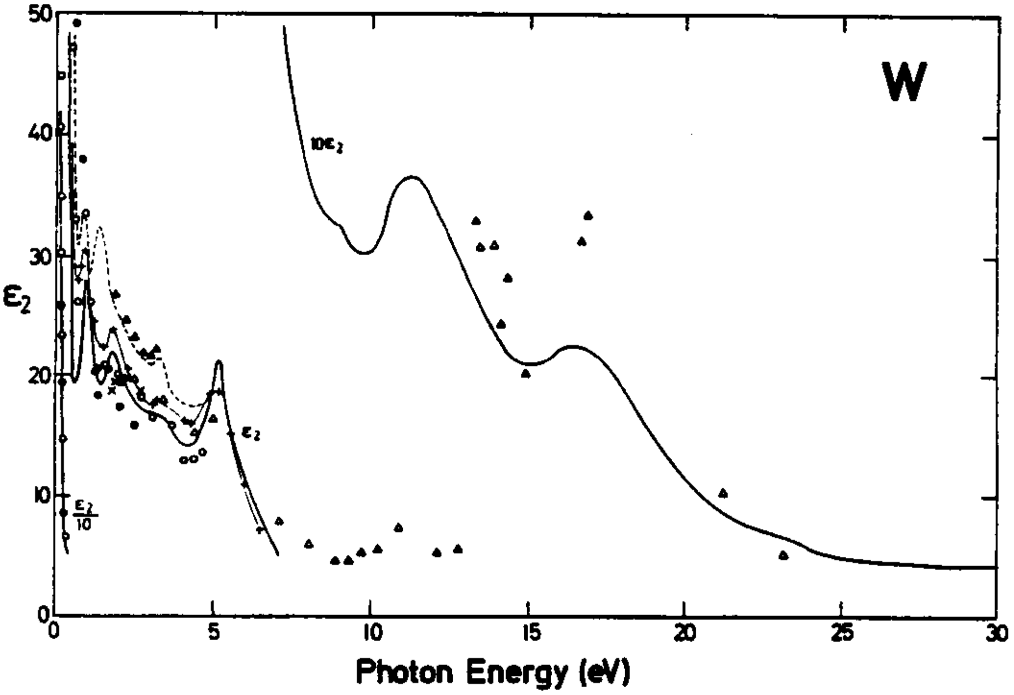

Fig. 82 ε_2 for W. —— WLO75; xxx TSV65; --- TT76; +++ NC80; ▲▲▲ CM71; ΔΔΔ JLM68; ●●● LP66; ooo NKN71.

Tungsten

publication by J.H. Weaver, D.W. Lynch, and C.G. Olson in Phys. Rev. B 12, 1293 (1975) based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(=0)
0.06	-5684.92	5713.94	34.46	82.90	0.00	.983
0.07	-4752.86	3910.33	26.48	73.85	0.00	.983
0.08	-3956.81	2771.62	20.91	65.29	0.00	.983
0.09	-3305.86	2040.25	17.01	59.96	0.00	.983
0.10	-2795.56	1538.09	14.06	54.71	0.00	.983
0.12	-2049.44	937.37	10.10	46.38	0.00	.982
0.14	-1555.35	608.45	7.58	40.16	0.00	.982
0.16	-1212.35	417.97	5.92	35.32	0.00	.982
0.18	-967.62	297.27	4.72	31.46	0.00	.982
0.20	-785.64	219.03	3.87	28.30	0.00	.981
0.25	-497.24	114.72	2.56	22.44	0.00	.980
0.30	-332.28	67.10	1.83	18.32	0.00	.979
0.32	-283.67	58.10	1.72	16.93	0.00	.977
0.34	-243.85	53.68	1.71	15.71	0.00	.973
0.36	-212.76	53.47	1.82	14.70	0.00	.967
0.38	-189.11	51.59	1.86	13.88	0.00	.963
0.40	-170.02	51.26	1.94	13.18	0.00	.957
0.42	-155.81	48.43	1.92	12.63	0.00	.954
0.44	-143.25	44.13	1.82	12.11	0.00	.953
0.46	-131.49	39.12	1.69	11.59	0.00	.952
0.48	-120.01	33.97	1.53	11.06	0.00	.952
0.50	-108.67	29.50	1.40	10.52	0.00	.952
0.52	-97.84	26.00	1.30	9.98	0.00	.950
0.54	-87.71	23.24	1.23	9.45	0.00	.948
0.56	-78.40	21.49	1.20	8.94	0.00	.943
0.58	-69.90	19.85	1.17	8.44	0.00	.938
0.60	-61.88	19.27	1.21	7.96	0.00	.929
0.62	-54.96	19.33	1.28	7.52	0.01	.917
0.64	-49.08	19.41	1.36	7.14	0.01	.904
0.66	-43.88	19.63	1.45	6.78	0.01	.888
0.68	-39.34	19.61	1.52	6.45	0.01	.873
0.70	-35.02	19.50	1.59	6.13	0.01	.856
0.72	-30.82	19.78	1.70	5.81	0.01	.834
0.74	-27.13	20.23	1.83	5.52	0.02	.810
0.76	-23.86	20.76	1.97	5.27	0.02	.785
0.78	-20.97	21.37	2.12	5.04	0.02	.759
0.80	-18.60	21.55	2.22	4.85	0.03	.738
0.82	-15.67	21.75	2.36	4.61	0.03	.710
0.83	-13.90	22.11	2.47	4.47	0.03	.692
0.84	-12.22	22.94	2.62	4.17	0.03	.674
0.85	-10.89	24.21	2.80	4.33	0.03	.662
0.86	-10.54	25.49	2.92	4.37	0.03	.661
0.87	-10.33	26.33	3.00	4.39	0.03	.660
0.88	-10.20	26.93	3.05	4.42	0.03	.560
0.90	-10.04	27.66	3.11	4.44	0.03	.660
0.92	-9.90	27.96	3.14	4.45	0.03	.660
0.94	-9.70	27.97	3.15	4.43	0.03	.658
0.96	-9.50	27.77	3.15	4.41	0.03	.656
0.98	-9.14	27.45	3.15	4.36	0.03	.653

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
1.00	-6.80	27.11	3.14	4.32	0.03	.649
1.05	-7.91	26.04	3.11	4.19	0.04	.639
1.10	-7.00	24.63	3.05	4.04	0.04	.627
1.15	-5.51	23.15	3.02	3.83	0.04	.608
1.20	-4.23	21.88	3.00	3.64	0.04	.590
1.25	-2.23	20.68	3.05	3.39	0.05	.563
1.30	-0.76	20.18	3.12	3.24	0.05	.545
1.35	0.78	19.63	3.20	3.07	0.05	.527
1.40	2.07	19.44	3.29	2.96	0.05	.515
1.45	3.30	19.28	3.38	2.85	0.05	.505
1.50	4.32	19.38	3.48	2.79	0.05	.500
1.55	5.25	19.46	3.56	2.73	0.05	.496
1.60	6.28	19.69	3.67	2.68	0.05	.494
1.65	6.92	20.55	3.78	2.72	0.04	.500
1.70	6.99	21.39	3.84	2.79	0.04	.507
1.75	6.64	21.99	3.85	2.86	0.04	.514
1.80	6.09	22.22	3.82	2.91	0.04	.518
1.85	5.46	22.15	3.76	2.95	0.04	.520
1.90	5.05	21.71	3.70	2.94	0.04	.518
1.95	4.77	21.33	3.65	2.92	0.04	.516
2.00	4.61	20.86	3.60	2.89	0.05	.512
2.05	4.55	20.45	3.57	2.86	0.05	.509
2.10	4.49	20.09	3.54	2.84	0.05	.506
2.15	4.43	19.70	3.51	2.81	0.05	.502
2.20	4.60	19.24	3.49	2.76	0.05	.497
2.25	4.78	19.08	3.50	2.73	0.05	.494
2.30	4.80	19.04	3.49	2.72	0.05	.494
2.35	4.70	18.94	3.48	2.72	0.05	.493
2.40	4.52	18.80	3.45	2.72	0.05	.493
2.45	4.30	18.54	3.41	2.71	0.05	.491
2.50	4.20	18.11	3.38	2.68	0.05	.487
2.55	4.26	17.73	3.35	2.64	0.05	.483
2.60	4.30	17.48	3.34	2.62	0.05	.480
2.65	4.34	17.19	3.32	2.59	0.05	.476
2.70	4.46	16.91	3.31	2.55	0.06	.472
2.75	4.54	16.74	3.31	2.53	0.06	.470
2.80	4.70	16.48	3.31	2.49	0.06	.466
2.85	4.85	16.38	3.31	2.47	0.06	.464
2.90	5.02	16.25	3.32	2.45	0.06	.461
2.95	5.21	16.20	3.33	2.43	0.06	.460
3.00	5.37	16.22	3.35	2.42	0.06	.459
3.05	5.51	16.27	3.37	2.42	0.06	.459
3.10	5.66	16.37	3.39	2.41	0.05	.460
3.15	5.74	16.60	3.41	2.43	0.05	.462
3.20	5.78	16.82	3.43	2.45	0.05	.465
3.25	5.73	17.19	3.45	2.49	0.05	.469
3.30	5.41	17.64	3.45	2.55	0.05	.476
3.35	4.97	17.85	3.43	2.60	0.05	.480
3.40	4.38	18.02	3.39	2.66	0.05	.485
3.45	3.70	17.92	3.32	2.70	0.05	.489
3.50	3.19	17.52	3.24	2.70	0.06	.489
3.55	2.90	17.11	3.18	2.69	0.06	.485
3.60	2.69	16.75	3.13	2.67	0.05	.482
3.65	2.50	16.40	3.09	2.65	0.06	.480
3.70	2.42	16.00	3.05	2.62	0.06	.476
3.75	2.36	15.67	3.02	2.60	0.06	.472
3.80	2.41	15.30	2.99	2.56	0.06	.468

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
3.85	2.46	15.06	2.98	2.53	0.06	.464
3.90	2.52	14.79	2.96	2.50	0.07	.460
3.95	2.66	14.51	2.95	2.46	0.07	.455
4.00	2.83	14.33	2.95	2.43	0.07	.451
4.10	3.23	14.07	2.97	2.37	0.07	.444
4.20	3.68	14.02	3.02	2.33	0.07	.440
4.30	4.06	14.21	3.07	2.31	0.07	.440
4.40	4.38	14.52	3.13	2.32	0.06	.442
4.50	4.62	14.99	3.19	2.35	0.06	.447
4.60	4.69	15.63	3.24	2.41	0.06	.455
4.70	4.67	16.30	3.29	2.48	0.06	.464
4.80	4.50	17.14	3.33	2.57	0.05	.475
4.90	4.19	18.10	3.37	2.68	0.05	.487
5.00	3.44	19.37	3.40	2.85	0.05	.505
5.10	2.10	20.58	3.38	3.05	0.05	.525
5.20	0.00	21.40	3.27	3.27	0.05	.548
5.30	-2.05	21.34	3.11	3.43	0.05	.566
5.40	-4.31	20.90	2.92	3.58	0.05	.586
5.50	-6.35	19.68	2.68	3.68	0.05	.604
5.60	-7.78	17.98	2.43	3.70	0.05	.618
5.70	-8.66	16.15	2.20	3.67	0.05	.629
5.80	-9.00	14.41	2.00	3.61	0.05	.637
5.90	-9.01	12.90	1.83	3.52	0.05	.641
6.00	-8.85	11.63	1.70	3.42	0.05	.643
6.10	-8.62	10.54	1.58	3.33	0.06	.644
6.20	-8.35	9.53	1.47	3.24	0.06	.646
6.30	-7.93	8.68	1.38	3.14	0.06	.643
6.40	-7.51	7.99	1.32	3.04	0.07	.640
6.50	-7.10	7.43	1.26	2.95	0.07	.635
6.60	-6.76	6.92	1.21	2.87	0.07	.631
6.70	-6.41	6.46	1.16	2.78	0.08	.626
6.80	-6.04	6.08	1.12	2.70	0.08	.619
6.90	-5.72	5.73	1.09	2.63	0.09	.613
7.00	-5.41	5.42	1.06	2.56	0.09	.607
7.10	-5.10	5.18	1.04	2.49	0.10	.598
7.20	-4.86	4.91	1.01	2.43	0.10	.593
7.30	-4.57	4.68	0.99	2.36	0.11	.583
7.40	-4.31	4.49	0.98	2.30	0.12	.573
7.50	-4.08	4.31	0.96	2.24	0.12	.565
7.60	-3.85	4.14	0.95	2.18	0.13	.556
7.70	-3.62	3.97	0.94	2.12	0.14	.546
7.80	-3.38	3.83	0.93	2.06	0.15	.533
7.90	-3.14	3.73	0.93	2.00	0.16	.518
8.00	-2.93	3.66	0.94	1.95	0.17	.505
8.10	-2.77	3.57	0.94	1.91	0.17	.494
8.20	-2.58	3.48	0.94	1.86	0.19	.481
8.30	-2.38	3.41	0.94	1.81	0.20	.465
8.40	-2.20	3.37	0.96	1.76	0.21	.449
8.50	-2.04	3.36	0.97	1.73	0.22	.434
8.60	-1.91	3.35	0.99	1.70	0.23	.422
8.70	-1.79	3.33	1.00	1.67	0.23	.411
8.80	-1.69	3.32	1.01	1.65	0.24	.401
8.90	-1.61	3.30	1.02	1.63	0.24	.394
9.00	-1.54	3.26	1.01	1.60	0.25	.389
9.10	-1.44	3.21	1.02	1.57	0.26	.373
9.20	-1.35	3.17	1.02	1.55	0.27	.369
9.30	-1.26	3.14	1.03	1.52	0.27	.360

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
9.40	-1.17	3.09	1.03	1.50	0.28	.352
9.50	-1.06	3.05	1.04	1.47	0.29	.340
9.60	-0.96	3.03	1.05	1.44	0.30	.329
9.70	-0.85	3.02	1.07	1.41	0.31	.318
9.80	-0.73	3.01	1.09	1.38	0.31	.307
9.90	-0.63	3.02	1.11	1.36	0.32	.297
10.00	-0.52	3.05	1.13	1.34	0.32	.287
10.10	-0.41	3.10	1.16	1.33	0.32	.278
10.20	-0.34	3.16	1.19	1.33	0.31	.274
10.30	-0.27	3.23	1.22	1.33	0.31	.271
10.40	-0.24	3.32	1.24	1.34	0.30	.270
10.50	-0.22	3.39	1.26	1.35	0.29	.271
10.60	-0.22	3.47	1.27	1.36	0.29	.274
10.70	-0.24	3.53	1.28	1.39	0.28	.278
10.80	-0.28	3.59	1.29	1.39	0.28	.282
10.90	-0.32	3.62	1.29	1.41	0.27	.286
11.00	-0.37	3.64	1.28	1.42	0.27	.290
11.10	-0.41	3.65	1.28	1.43	0.27	.293
11.20	-0.46	3.66	1.27	1.44	0.27	.297
11.30	-0.51	3.66	1.26	1.45	0.27	.301
11.40	-0.56	3.66	1.25	1.46	0.27	.305
11.50	-0.62	3.64	1.24	1.47	0.27	.309
11.60	-0.68	3.61	1.22	1.48	0.27	.313
11.70	-0.72	3.57	1.21	1.48	0.27	.315
11.80	-0.76	3.54	1.20	1.49	0.27	.319
11.90	-0.81	3.49	1.18	1.48	0.27	.321
12.00	-0.84	3.44	1.16	1.48	0.27	.323
12.20	-0.90	3.34	1.13	1.48	0.28	.327
12.40	-0.94	3.23	1.10	1.47	0.29	.329
12.60	-0.97	3.12	1.07	1.46	0.29	.332
12.80	-0.99	2.99	1.04	1.44	0.30	.333
13.00	-1.00	2.87	1.01	1.42	0.31	.333
13.20	-0.99	2.75	0.98	1.40	0.32	.332
13.40	-0.96	2.64	0.96	1.37	0.33	.329
13.60	-0.93	2.53	0.94	1.35	0.35	.325
13.80	-0.88	2.43	0.92	1.32	0.36	.320
14.00	-0.81	2.34	0.91	1.28	0.38	.312
14.20	-0.75	2.27	0.91	1.25	0.40	.304
14.40	-0.69	2.21	0.90	1.23	0.41	.296
14.60	-0.62	2.16	0.90	1.20	0.43	.286
14.80	-0.55	2.12	0.90	1.17	0.44	.276
15.00	-0.47	2.10	0.92	1.14	0.45	.264
15.20	-0.40	2.11	0.93	1.13	0.46	.255
15.40	-0.35	2.13	0.95	1.12	0.46	.249
15.60	-0.33	2.17	0.97	1.12	0.45	.246
15.80	-0.32	2.20	0.98	1.13	0.44	.246
16.00	-0.34	2.24	0.99	1.14	0.44	.249
16.20	-0.37	2.26	0.98	1.15	0.43	.253
16.40	-0.42	2.27	0.97	1.17	0.43	.260
16.60	-0.47	2.27	0.96	1.18	0.42	.267
16.80	-0.53	2.25	0.94	1.19	0.42	.273
17.00	-0.59	2.21	0.92	1.20	0.42	.282
17.20	-0.64	2.17	0.90	1.21	0.42	.289
17.40	-0.70	2.11	0.87	1.21	0.43	.297
17.60	-0.74	2.05	0.85	1.21	0.43	.304
17.80	-0.77	1.98	0.82	1.20	0.44	.310
18.00	-0.80	1.91	0.80	1.20	0.45	.317

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
18.20	-0.83	1.83	0.77	1.19	0.45	.325
18.40	-0.84	1.74	0.74	1.18	0.47	.330
18.60	-0.85	1.66	0.71	1.16	0.48	.335
18.80	-0.84	1.58	0.69	1.15	0.49	.340
19.00	-0.83	1.50	0.67	1.13	0.51	.343
19.20	-0.82	1.43	0.64	1.11	0.53	.347
19.40	-0.81	1.36	0.62	1.09	0.55	.350
19.60	-0.79	1.28	0.60	1.07	0.57	.353
19.80	-0.76	1.21	0.58	1.05	0.59	.354
20.00	-0.72	1.15	0.56	1.02	0.62	.354
20.20	-0.69	1.09	0.55	0.99	0.66	.352
20.40	-0.65	1.04	0.54	0.97	0.69	.350
20.60	-0.61	0.99	0.52	0.94	0.73	.347
20.80	-0.57	0.95	0.52	0.92	0.77	.342
21.00	-0.54	0.91	0.51	0.89	0.82	.338
21.20	-0.50	0.87	0.50	0.87	0.87	.331
21.40	-0.46	0.84	0.50	0.84	0.92	.325
21.60	-0.43	0.81	0.50	0.82	0.97	.318
21.80	-0.39	0.78	0.49	0.80	1.02	.312
22.00	-0.36	0.76	0.49	0.77	1.08	.303
22.20	-0.32	0.74	0.49	0.75	1.14	.295
22.40	-0.29	0.72	0.49	0.73	1.20	.287
22.60	-0.26	0.70	0.49	0.71	1.25	.279
22.80	-0.24	0.69	0.49	0.69	1.30	.272
23.00	-0.22	0.67	0.49	0.68	1.35	.267
23.20	-0.20	0.65	0.49	0.66	1.41	.263
23.40	-0.18	0.63	0.49	0.64	1.48	.259
23.60	-0.15	0.60	0.48	0.62	1.56	.252
23.80	-0.12	0.58	0.48	0.60	1.65	.244
24.00	-0.09	0.56	0.49	0.57	1.74	.234
24.20	-0.07	0.54	0.49	0.55	1.81	.224
24.40	-0.04	0.53	0.50	0.53	1.88	.213
24.60	-0.01	0.52	0.50	0.51	1.94	.203
24.80	0.02	0.50	0.51	0.49	1.98	.191
25.00	0.04	0.50	0.52	0.48	2.00	.180
25.20	0.07	0.49	0.53	0.46	2.02	.171
25.40	0.09	0.48	0.54	0.44	2.02	.161
25.60	0.12	0.47	0.55	0.43	2.00	.150
25.80	0.14	0.47	0.56	0.41	1.97	.140
26.00	0.16	0.46	0.57	0.40	1.92	.132
26.20	0.18	0.46	0.58	0.39	1.89	.125
26.40	0.20	0.45	0.59	0.38	1.84	.117
26.60	0.22	0.45	0.60	0.38	1.79	.111
26.80	0.24	0.45	0.61	0.37	1.74	.105
27.00	0.25	0.44	0.62	0.36	1.70	.099
27.25	0.28	0.44	0.63	0.35	1.63	.092
27.50	0.30	0.43	0.64	0.34	1.56	.085
27.75	0.32	0.43	0.66	0.33	1.49	.079
28.00	0.35	0.43	0.67	0.32	1.41	.073
28.25	0.36	0.43	0.68	0.32	1.37	.070
28.50	0.38	0.43	0.69	0.31	1.31	.065
28.75	0.40	0.43	0.70	0.31	1.26	.061
29.00	0.42	0.43	0.71	0.30	1.20	.057
29.25	0.44	0.43	0.72	0.30	1.15	.054
29.50	0.45	0.44	0.73	0.30	1.11	.052
29.75	0.46	0.44	0.74	0.30	1.08	.049
30.00	0.47	0.44	0.75	0.29	1.05	.047

Energy (eV)	ϵ_1	ϵ_2	n	k	$\mathrm{Im}(-1/\tilde{\epsilon})$	$R(\phi=0)$
30.50	0.50	0.45	0.76	0.29	1.00	.044
31.00	0.52	0.46	0.78	0.29	0.96	.042
31.50	0.53	0.46	0.79	0.29	0.93	.040
32.00	0.54	0.47	0.79	0.29	0.92	.040
32.50	0.55	0.46	0.80	0.29	0.89	.037
33.00	0.59	0.45	0.82	0.28	0.82	.033
33.50	0.61	0.47	0.83	0.28	0.80	.032
34.00	0.62	0.49	0.84	0.29	0.79	.032
34.50	0.62	0.50	0.85	0.30	0.78	.032
35.00	0.63	0.52	0.85	0.31	0.79	.033
36.00	0.61	0.54	0.85	0.32	0.81	.036
37.00	0.59	0.55	0.84	0.33	0.84	.039
38.00	0.57	0.54	0.83	0.33	0.87	.040
39.00	0.55	0.54	0.81	0.33	0.90	.042
40.00	0.53	0.52	0.80	0.33	0.95	.045

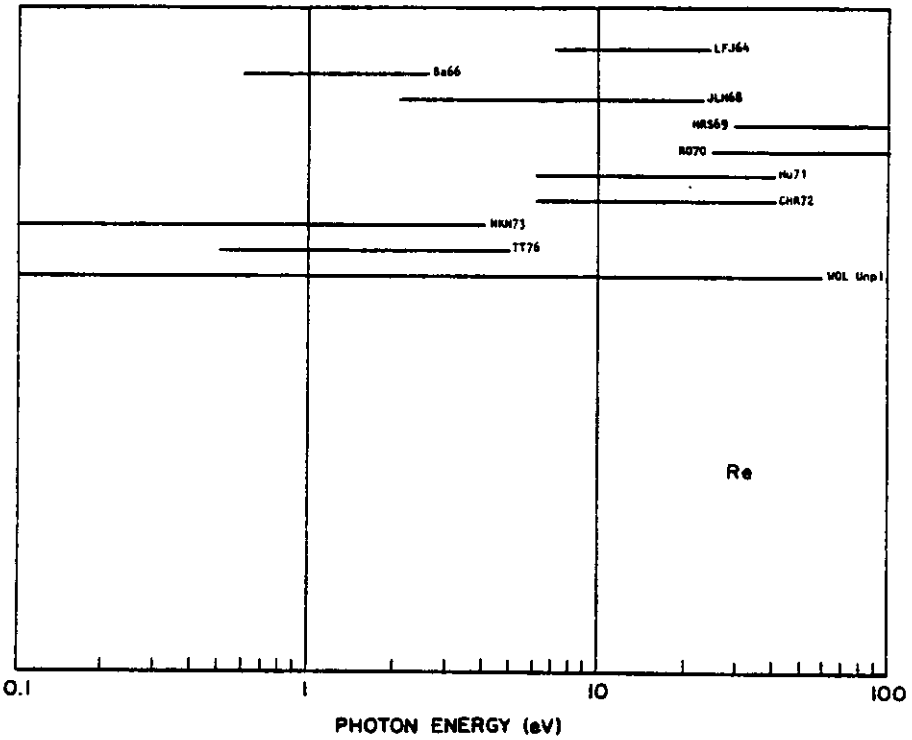

Fig. 84 Survey of available data for Re

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Re
LFJ64	7.1-23.6	Refl				x	Heat	R	
Ba66	0.6-2.6	Ellips	300-2400			x	Heat	n,k	cross-section filaments at various T
JLM68	2.15-23.09	Refl				x	Heat	R; KK: $n,k,\varepsilon_1,\varepsilon_2$	heated $\sim$2600 K at $\sim 10^{-9}$ Torr
HRS69	30-600	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
RO70	$\sim$25-$\sim$170	m-θ						R,n,μ	
Hu71	6.2-41.3	Refl		x			Ex	R	
CHR72	6.2-41.3	Refl		x			Ex	R	
Log72					x			ε	emissivity
NKN73	0.08-4.13	Ellips	77, 295			x	EP	n,k,σ,ε_1	table λ,n,k
Zho74			>1000					ε	emissivity
TT76	0.5-5	Ellips	4.2			x	Heat	ε_2 (interband)	$\sim$2000 K in uhv
WOL Unpl	0.1-60	Refl	4.2 K for $h\nu < 4.4$ eV RT for $h\nu > 4.4$ eV		x		EP	$\underline{R}$; KK: $n,\underline{k},\varepsilon_1,\varepsilon_2$; $\vec{E}\perp\hat{c}$ and $\vec{E}\parallel\hat{c}$	absorptivity measured by calorimetry for $h\nu < 4.4$ eV, reflectivity measured for $h\nu > 4.4$ eV with synchrotron radiation

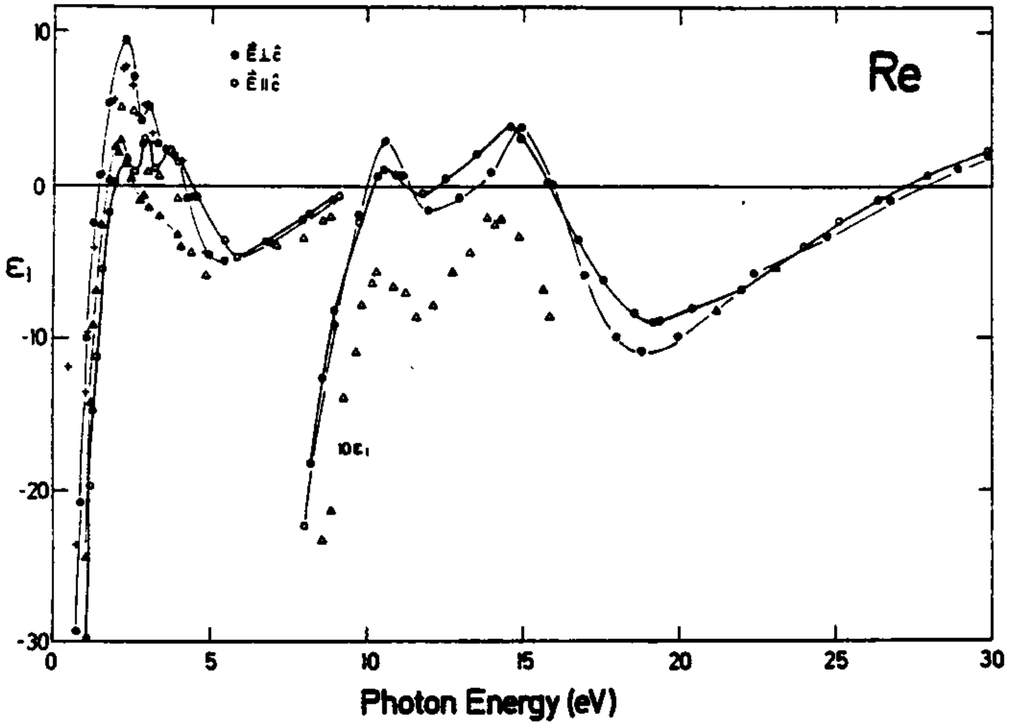

Fig. 86 ε_1 for Re. Single crystal results shown as ●●● for $\vec{E}\parallel\hat{c}$ and ○○○ for $\vec{E}\perp\hat{c}$ by LOW (unpub). Polycrystalline results as follows: +++ TT76; ▲▲▲ NKN73; △△△ JLM68.

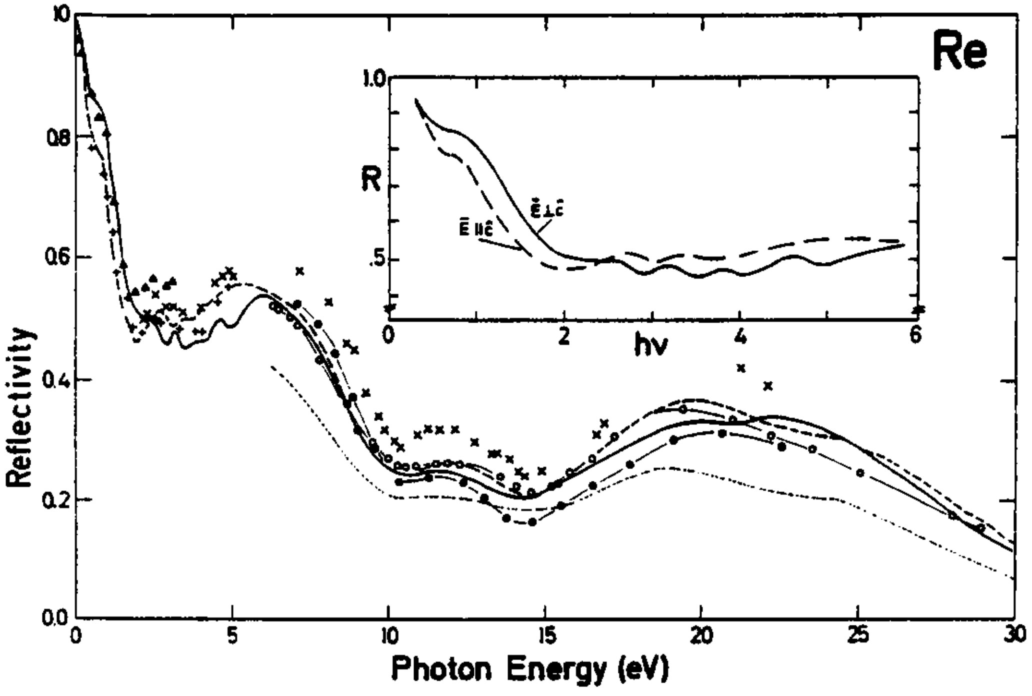

Fig. 85 Reflectivity for Re. Results for single crystal shown as — — for $\vec{E}\parallel\hat{c}$ and —— for $\vec{E}\perp\hat{c}$ by LOW (unpub). Polycrystalline results as follows: ○○○ CHR72; xxx JLM68; --- Hu71; +++ TT76; ▲▲▲ NKN73; ●●● LFJ64.

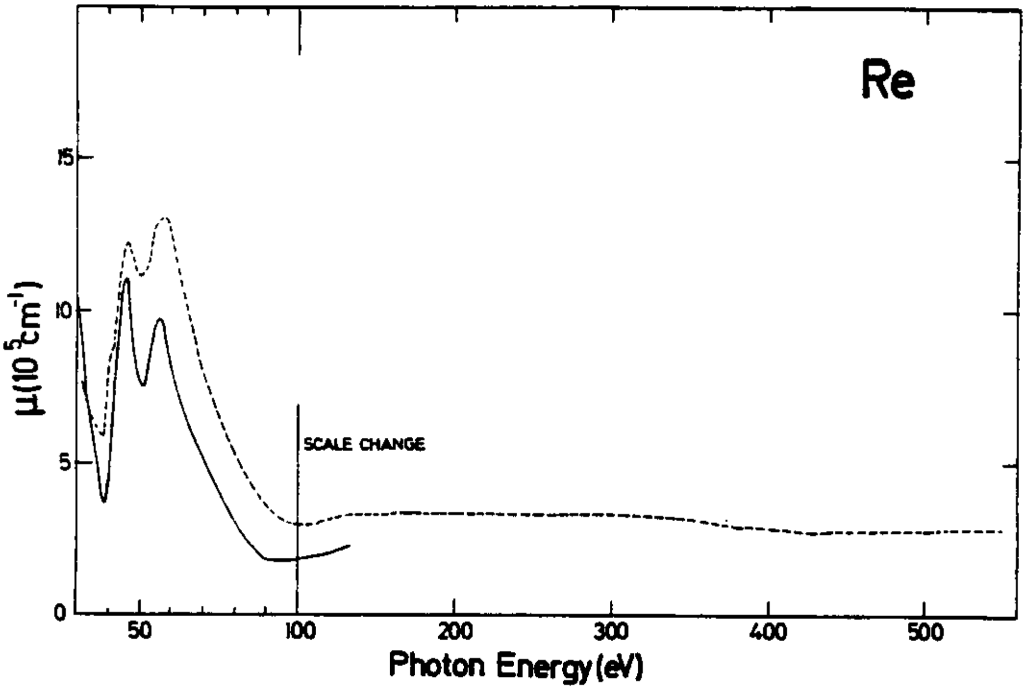

Fig. 88 Absorption coefficient for Re. --- HRS69; —— Ro70.

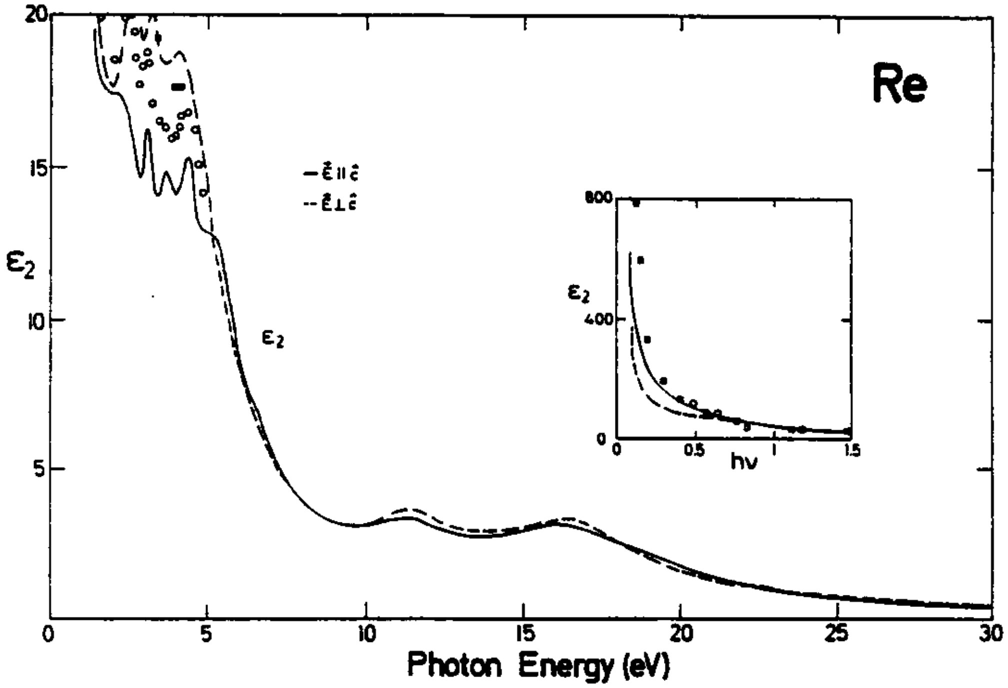

Fig. 87 ϵ_2 for Re. Single crystal shown as --- for $\vec{E}\parallel\hat{c}$ and —— for $\vec{E}\perp\hat{c}$ by LOW (unpub). Polycrystalline results as follows: ooo TT76; □□□NKN73.

Rhenium single crystal with $\vec{E} \parallel \hat{c}$

J.H. Weaver, C.G. Olson, and D.W. Lynch, unpublished

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
0.10	-2567.21	618.75	6.06	51.03	0.00	.991
0.15	-1131.18	316.57	4.66	33.96	0.00	.984
0.20	-625.69	211.18	4.16	25.36	0.00	.975
0.25	-387.89	162.12	4.03	20.10	0.00	.962
0.30	-259.57	145.83	4.37	16.69	0.00	.943
0.35	-190.79	130.66	4.50	14.53	0.00	.925
0.40	-147.43	117.49	4.53	12.96	0.00	.909
0.45	-118.24	106.71	4.53	11.78	0.00	.893
0.50	-97.87	98.71	4.53	10.88	0.01	.879
0.55	-84.97	92.21	4.50	10.26	0.01	.867
0.57	-81.69	87.74	4.37	10.04	0.01	.865
0.60	-76.71	83.69	4.29	9.75	0.01	.861
0.63	-73.32	80.24	4.20	9.54	0.01	.858
0.65	-70.85	76.15	4.07	9.35	0.01	.856
0.68	-68.03	72.02	3.94	9.14	0.01	.854
0.70	-65.56	67.94	3.80	8.94	0.01	.853
0.73	-63.19	63.88	3.65	8.75	0.01	.851
0.75	-60.93	59.48	3.48	8.55	0.01	.850
0.77	-57.93	55.60	3.34	8.31	0.01	.848
0.80	-55.33	52.02	3.21	8.10	0.01	.846
0.85	-50.17	45.38	2.96	7.68	0.01	.841
0.90	-44.94	39.49	2.73	7.24	0.01	.835
0.95	-39.54	34.75	2.56	6.79	0.01	.826
1.00	-34.42	31.18	2.45	6.36	0.01	.813
1.05	-29.91	28.56	2.39	5.96	0.02	.797
1.10	-25.84	26.68	2.38	5.61	0.02	.778
1.15	-22.65	25.04	2.36	5.31	0.02	.761
1.20	-19.70	23.61	2.35	5.02	0.02	.742
1.25	-17.00	22.58	2.37	4.76	0.03	.721
1.30	-14.85	21.71	2.39	4.54	0.03	.702
1.35	-12.93	20.85	2.41	4.33	0.03	.683
1.40	-11.12	20.12	2.44	4.13	0.04	.662
1.45	-9.56	19.49	2.46	3.95	0.04	.643
1.50	-8.11	18.92	2.50	3.79	0.04	.624
1.55	-6.74	18.44	2.54	3.63	0.05	.605
1.60	-5.49	18.06	2.59	3.49	0.05	.587
1.65	-4.30	17.81	2.65	3.36	0.05	.570
1.70	-3.37	17.65	2.70	3.27	0.05	.557
1.75	-2.43	17.50	2.76	3.17	0.06	.544
1.80	-1.69	17.50	2.82	3.10	0.06	.535
1.85	-1.12	17.46	2.86	3.05	0.06	.527
1.90	-0.56	17.39	2.90	3.00	0.06	.520
1.95	-0.11	17.37	2.94	2.96	0.06	.515
2.00	0.33	17.32	2.97	2.91	0.06	.510
2.05	0.65	17.35	3.00	2.89	0.06	.507
2.10	0.94	17.33	3.03	2.86	0.06	.504
2.15	1.18	17.35	3.05	2.85	0.06	.502
2.20	1.32	17.37	3.06	2.84	0.06	.501
2.25	1.40	17.35	3.07	2.83	0.06	.500

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
2.30	1.46	17.31	3.07	2.82	0.06	.499
2.35	1.51	17.25	3.07	2.81	0.06	.498
2.40	1.48	17.23	3.05	2.81	0.06	.498
2.45	1.37	17.13	3.05	2.81	0.06	.498
2.50	1.25	16.93	3.02	2.80	0.06	.497
2.55	1.18	16.68	2.99	2.79	0.06	.495
2.60	1.08	16.40	2.96	2.77	0.06	.493
2.65	1.03	16.00	2.92	2.74	0.06	.489
2.70	1.19	15.53	2.89	2.68	0.06	.482
2.75	1.45	15.16	2.89	2.63	0.07	.475
2.80	1.78	14.87	2.89	2.57	0.07	.468
2.85	2.31	14.65	2.93	2.50	0.07	.460
2.90	2.86	14.79	2.99	2.47	0.07	.457
2.95	3.23	15.24	3.07	2.48	0.06	.460
3.00	3.07	15.93	3.11	2.57	0.06	.470
3.05	2.62	16.22	3.09	2.63	0.06	.477
3.10	2.08	16.26	3.04	2.67	0.06	.482
3.15	1.57	16.03	2.97	2.70	0.06	.484
3.20	1.24	15.57	2.90	2.68	0.06	.482
3.25	1.19	15.02	2.85	2.63	0.07	.476
3.30	1.36	14.60	2.83	2.58	0.07	.469
3.35	1.53	14.36	2.83	2.54	0.07	.464
3.40	1.76	14.17	2.83	2.50	0.07	.459
3.50	2.31	14.06	2.88	2.44	0.07	.452
3.60	2.45	14.52	2.93	2.48	0.07	.457
3.70	1.99	14.88	2.91	2.55	0.07	.466
3.80	1.59	14.64	2.86	2.56	0.07	.467
3.90	1.48	14.31	2.82	2.54	0.07	.464
4.00	1.60	14.11	2.81	2.51	0.07	.460
4.10	1.75	14.23	2.84	2.51	0.07	.460
4.20	1.68	14.63	2.86	2.55	0.07	.466
4.30	1.20	15.11	2.86	2.64	0.07	.477
4.40	0.38	15.36	2.81	2.74	0.07	.489
4.50	-0.65	15.19	2.70	2.82	0.07	.500
4.60	-1.42	14.50	2.56	2.83	0.07	.504
4.70	-1.68	13.66	2.46	2.78	0.07	.501
4.80	-1.57	13.07	2.41	2.71	0.08	.493
4.90	-1.43	12.82	2.39	2.68	0.08	.498
5.00	-1.44	12.81	2.39	2.68	0.08	.499
5.10	-1.69	12.86	2.38	2.71	0.08	.493
5.20	-2.09	12.83	2.34	2.75	0.08	.500
5.30	-2.59	12.66	2.27	2.79	0.08	.508
5.40	-3.05	12.37	2.20	2.81	0.08	.515
5.50	-3.56	11.99	2.12	2.83	0.08	.523
5.60	-4.00	11.45	2.02	2.84	0.08	.530
5.70	-4.27	10.85	1.92	2.82	0.08	.534
5.80	-4.49	10.27	1.83	2.80	0.09	.539
5.90	-4.67	9.62	1.74	2.77	0.08	.542
6.00	-4.65	8.95	1.65	2.71	0.09	.541
6.20	-4.33	7.99	1.54	2.59	0.10	.532
6.40	-4.13	7.26	1.45	2.50	0.10	.526
6.80	-3.61	6.11	1.32	2.31	0.12	.508
7.00	-3.39	5.64	1.26	2.23	0.13	.500
7.20	-3.18	5.18	1.20	2.15	0.14	.491
7.40	-2.91	4.79	1.15	2.06	0.15	.480
7.60	-2.70	4.43	1.12	1.99	0.16	.470
7.80	-2.42	4.09	1.08	1.84	0.16	.454

Re $\vec{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
8.00	-2.14	3.79	1.05	1.80	0.20	.435
8.20	-1.82	3.57	1.05	1.71	0.22	.411
8.40	-1.53	3.41	1.05	1.62	0.24	.396
8.60	-1.26	3.29	1.06	1.55	0.27	.360
8.80	-1.01	3.22	1.09	1.48	0.28	.336
9.00	-0.82	3.18	1.11	1.43	0.29	.317
9.20	-0.65	3.13	1.13	1.39	0.31	.301
9.40	-0.44	3.11	1.16	1.34	0.32	.281
9.60	-0.35	3.14	1.18	1.32	0.31	.274
9.80	-0.24	3.11	1.20	1.29	0.32	.264
10.00	-0.09	3.10	1.23	1.26	0.32	.252
10.20	0.00	3.14	1.25	1.25	0.32	.246
10.40	0.07	3.18	1.28	1.25	0.31	.242
10.60	0.11	3.24	1.29	1.25	0.31	.242
10.80	0.11	3.29	1.30	1.26	0.30	.244
11.00	0.08	3.31	1.30	1.27	0.30	.247
11.20	0.04	3.30	1.29	1.28	0.30	.249
11.40	-0.01	3.28	1.28	1.28	0.31	.252
11.60	-0.05	3.21	1.26	1.28	0.31	.252
11.80	-0.06	3.12	1.24	1.26	0.32	.249
12.00	-0.03	3.05	1.23	1.24	0.33	.244
12.20	0.00	3.00	1.22	1.23	0.33	.241
12.40	0.02	2.95	1.22	1.21	0.34	.237
12.60	0.05	2.91	1.22	1.20	0.34	.233
12.80	0.07	2.88	1.21	1.18	0.35	.230
13.00	0.11	2.84	1.22	1.17	0.35	.225
13.20	0.14	2.82	1.22	1.16	0.35	.222
13.40	0.18	2.79	1.22	1.14	0.36	.218
13.60	0.21	2.78	1.22	1.13	0.36	.215
13.80	0.24	2.77	1.23	1.13	0.36	.212
14.00	0.28	2.77	1.24	1.12	0.36	.209
14.20	0.32	2.78	1.25	1.11	0.36	.206
14.40	0.37	2.81	1.27	1.11	0.35	.204
14.60	0.40	2.88	1.29	1.12	0.34	.206
14.80	0.36	2.97	1.29	1.15	0.33	.213
15.00	0.31	3.01	1.29	1.16	0.33	.218
15.20	0.24	3.06	1.29	1.19	0.33	.225
15.40	0.18	3.07	1.27	1.20	0.32	.230
15.60	0.10	3.08	1.26	1.22	0.32	.236
15.80	0.03	3.08	1.25	1.24	0.32	.241
16.00	-0.05	3.08	1.23	1.25	0.32	.248
16.20	-0.14	3.06	1.21	1.26	0.33	.254
16.40	-0.21	3.02	1.19	1.27	0.33	.259
16.60	-0.29	2.99	1.16	1.28	0.33	.264
16.80	-0.36	2.94	1.14	1.29	0.33	.269
17.60	-0.62	2.71	1.04	1.30	0.35	.291
17.00	-0.44	2.90	1.12	1.30	0.34	.275
17.20	-0.50	2.84	1.09	1.30	0.34	.280
17.40	-0.56	2.78	1.07	1.30	0.35	.286
17.80	-0.64	2.64	1.01	1.30	0.36	.296
18.00	-0.72	2.56	0.99	1.30	0.36	.300
18.20	-0.76	2.49	0.96	1.30	0.37	.305
18.40	-0.81	2.40	0.93	1.29	0.37	.311
18.60	-0.84	2.32	0.90	1.29	0.38	.316
18.80	-0.87	2.23	0.87	1.28	0.39	.321
19.00	-0.89	2.13	0.84	1.27	0.40	.325
19.20	-0.90	2.04	0.81	1.25	0.41	.330

Re $\vec{E} \parallel \hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
19.40	-0.90	1.94	0.79	1.23	0.42	.332
19.60	-0.88	1.86	0.77	1.21	0.44	.332
19.80	-0.87	1.78	0.75	1.19	0.45	.333
20.00	-0.85	1.71	0.73	1.18	0.47	.333
20.20	-0.83	1.65	0.71	1.16	0.48	.333
20.40	-0.81	1.59	0.70	1.14	0.50	.332
20.80	-0.77	1.48	0.67	1.11	0.53	.332
21.20	-0.75	1.38	0.64	1.08	0.56	.334
21.60	-0.71	1.28	0.61	1.04	0.60	.335
22.00	-0.69	1.18	0.58	1.01	0.63	.340
22.40	-0.64	1.08	0.55	0.97	0.69	.341
22.80	-0.58	0.99	0.53	0.93	0.75	.338
23.20	-0.53	0.91	0.51	0.89	0.82	.334
23.60	-0.47	0.84	0.50	0.85	0.91	.329
24.00	-0.41	0.78	0.48	0.80	1.01	.319
24.40	-0.35	0.73	0.48	0.76	1.12	.307
24.80	-0.30	0.68	0.47	0.72	1.23	.296
25.20	-0.24	0.64	0.47	0.68	1.35	.282
25.60	-0.19	0.61	0.47	0.65	1.49	.270
26.00	-0.15	0.58	0.47	0.61	1.63	.255
26.40	-0.10	0.55	0.48	0.57	1.77	.240
26.80	-0.06	0.52	0.48	0.54	1.90	.225
27.20	-0.02	0.50	0.49	0.51	2.00	.208
27.60	0.02	0.48	0.50	0.48	2.09	.193
28.00	0.06	0.46	0.51	0.45	2.13	.176
29.00	0.14	0.42	0.54	0.39	2.15	.145
30.00	0.22	0.38	0.57	0.33	1.99	.114
31.00	0.30	0.35	0.62	0.29	1.66	.086
32.00	0.37	0.34	0.66	0.26	1.37	.065
32.50	0.38	0.34	0.67	0.25	1.29	.060
33.00	0.41	0.32	0.68	0.24	1.19	.054
34.00	0.48	0.31	0.72	0.21	0.96	.041
35.00	0.54	0.31	0.76	0.20	0.80	.031
36.00	0.59	0.31	0.79	0.20	0.71	.025
37.00	0.64	0.32	0.82	0.19	0.63	.021
38.00	0.69	0.34	0.85	0.20	0.58	.019
39.00	0.74	0.38	0.89	0.21	0.55	.016
40.00	0.71	0.46	0.88	0.26	0.64	.022
41.00	0.70	0.45	0.87	0.26	0.65	.023
42.00	0.71	0.45	0.88	0.26	0.64	.022
43.00	0.72	0.47	0.89	0.27	0.64	.023
44.00	0.71	0.51	0.89	0.29	0.67	.026
45.00	0.67	0.54	0.88	0.31	0.73	.031
46.00	0.62	0.54	0.85	0.32	0.79	.035
47.00	0.60	0.51	0.83	0.31	0.83	.036
48.00	0.59	0.50	0.82	0.30	0.84	.036
49.00	0.57	0.49	0.81	0.30	0.86	.037
50.00	0.56	0.48	0.80	0.30	0.89	.039
51.00	0.54	0.48	0.79	0.30	0.92	.040
52.00	0.51	0.47	0.78	0.30	0.94	.044
53.00	0.48	0.46	0.75	0.30	1.05	.049
54.00	0.43	0.43	0.72	0.30	1.17	.055
55.00	0.39	0.38	0.69	0.27	1.27	.060
56.00	0.39	0.32	0.66	0.24	1.29	.061
57.00	0.38	0.26	0.65	0.20	1.23	.058
58.00	0.39	0.21	0.65	0.16	1.05	.055
59.00	0.41	0.15	0.65	0.12	0.83	.050

Rhenium single crystal with $\vec{E}\perp\hat{c}$

D.W. Lynch, C.G. Olson, and J.H. Weaver (unpub)

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
0.10	-1816.64	364.47	4.25	42.83	0.00	.991
0.15	-778.04	184.09	3.28	28.08	0.00	.984
0.20	-416.01	135.30	3.28	20.66	0.00	.971
0.25	-252.76	112.85	3.47	16.27	0.00	.951
0.30	-166.75	100.42	3.73	13.44	0.00	.926
0.35	-117.68	90.77	3.93	11.54	0.00	.900
0.40	-87.19	81.09	3.99	10.15	0.01	.875
0.45	-64.14	75.32	4.17	9.03	0.01	.846
0.50	-49.42	71.64	4.34	8.26	0.01	.821
0.55	-39.90	68.74	4.45	7.73	0.01	.801
0.57	-36.37	67.84	4.51	7.53	0.01	.793
0.60	-34.27	67.07	4.53	7.40	0.01	.788
0.63	-33.09	66.05	4.52	7.31	0.01	.785
0.65	-33.00	64.42	4.44	7.26	0.01	.784
0.68	-33.13	61.88	4.30	7.19	0.01	.784
0.70	-33.19	58.56	4.13	7.09	0.01	.784
0.73	-32.61	54.74	3.94	6.94	0.01	.783
0.75	-31.33	50.88	3.77	6.75	0.01	.779
0.77	-29.27	47.60	3.65	6.53	0.02	.773
0.80	-27.40	44.91	3.55	6.32	0.02	.766
0.85	-23.91	40.40	3.39	5.95	0.02	.752
0.90	-20.77	36.58	3.26	5.61	0.02	.737
0.95	-17.72	33.37	3.17	5.27	0.02	.719
1.00	-14.99	30.65	3.09	4.96	0.03	.701
1.05	-12.20	28.48	3.07	4.65	0.03	.678
1.10	-10.00	26.74	3.05	4.39	0.03	.658
1.15	-7.84	25.17	3.04	4.14	0.04	.636
1.20	-5.70	23.97	3.08	3.89	0.04	.613
1.25	-3.85	23.22	3.14	3.70	0.04	.593
1.30	-2.42	22.78	3.20	3.56	0.04	.578
1.35	-1.49	22.43	3.24	3.46	0.04	.567
1.40	-0.98	21.87	3.23	3.38	0.05	.559
1.45	-0.23	20.94	3.22	3.25	0.05	.546
1.50	0.69	20.14	3.23	3.12	0.05	.532
1.55	1.52	19.53	3.25	3.01	0.05	.520
1.60	2.51	18.93	3.29	2.88	0.05	.507
1.65	3.29	18.67	3.34	2.80	0.05	.499
1.70	4.03	18.34	3.38	2.72	0.05	.491
1.75	4.71	18.14	3.42	2.65	0.05	.485
1.80	5.38	17.99	3.47	2.59	0.05	.480
1.85	5.75	18.05	3.51	2.57	0.05	.479
1.90	6.27	17.69	3.54	2.50	0.05	.473
1.95	6.82	17.68	3.59	2.46	0.05	.471
2.00	7.33	17.64	3.63	2.43	0.05	.469
2.05	7.82	17.75	3.69	2.41	0.05	.469
2.10	8.21	17.92	3.74	2.40	0.05	.470
2.15	8.55	18.07	3.78	2.39	0.05	.471
2.20	8.96	18.23	3.83	2.39	0.04	.472
2.25	9.33	18.67	3.89	2.40	0.04	.476
2.30	9.48	19.20	3.93	2.44	0.04	.481
2.35	9.60	19.63	3.97	2.47	0.04	.485
2.40	9.52	20.36	4.00	2.55	0.04	.492
2.45	9.31	20.87	4.01	2.60	0.04	.497
2.50	8.78	21.66	4.01	2.70	0.04	.505
2.55	8.01	22.02	3.96	2.78	0.04	.510
2.60	7.16	22.19	3.90	2.84	0.04	.514
2.65	6.34	22.09	3.83	2.88	0.04	.516
2.70	5.52	21.83	3.74	2.92	0.04	.517
2.75	4.87	21.28	3.65	2.91	0.04	.515
2.80	4.46	20.61	3.57	2.88	0.05	.511
2.85	4.32	19.90	3.51	2.83	0.05	.505
2.90	4.62	19.25	3.49	2.75	0.05	.497
2.95	4.93	19.11	3.51	2.72	0.05	.494
3.00	5.16	19.12	3.53	2.71	0.05	.493
3.05	5.29	19.28	3.56	2.71	0.05	.494
3.10	5.28	19.57	3.57	2.74	0.05	.497
3.15	4.99	19.94	3.57	2.79	0.05	.502
3.20	4.53	20.11	3.55	2.84	0.05	.506
3.25	3.98	20.12	3.50	2.88	0.05	.509
3.30	3.50	19.93	3.44	2.89	0.05	.510
3.35	3.07	19.65	3.39	2.90	0.05	.510
3.40	2.81	19.26	3.34	2.88	0.05	.508
3.50	2.67	18.65	3.28	2.84	0.05	.503
3.60	2.57	18.38	3.25	2.83	0.05	.501
3.70	2.60	18.20	3.24	2.81	0.05	.499
3.80	2.44	18.38	3.24	2.84	0.05	.502
3.90	2.05	18.58	3.22	2.88	0.05	.507
4.00	1.49	18.74	3.19	2.94	0.05	.513
4.10	0.75	18.81	3.13	3.01	0.05	.520
4.20	-0.03	18.68	3.05	3.06	0.05	.526
4.30	-0.82	18.45	2.97	3.11	0.05	.532
4.40	-1.64	18.09	2.88	3.15	0.05	.539
4.50	-2.39	17.57	2.77	3.17	0.06	.544
4.60	-3.03	16.97	2.67	3.18	0.06	.548
4.70	-3.70	16.29	2.55	3.19	0.06	.553
4.80	-4.08	15.48	2.44	3.17	0.06	.554
4.90	-4.38	14.76	2.35	3.14	0.06	.555
5.00	-4.64	14.04	2.25	3.12	0.06	.556
5.10	-4.74	13.36	2.17	3.08	0.07	.555
5.20	-4.86	12.74	2.10	3.04	0.07	.555
5.30	-4.92	12.14	2.02	3.00	0.07	.554
5.40	-4.94	11.60	1.96	2.96	0.07	.553
5.50	-4.95	11.08	1.89	2.92	0.08	.552
5.60	-4.95	10.60	1.84	2.88	0.08	.551
5.70	-4.94	10.13	1.78	2.85	0.08	.550
5.80	-4.91	9.70	1.73	2.81	0.08	.549
5.90	-4.91	9.27	1.67	2.78	0.08	.549
6.00	-4.89	8.82	1.61	2.74	0.09	.549
6.20	-4.69	8.01	1.51	2.64	0.09	.545
6.40	-4.50	7.28	1.42	2.56	0.10	.541
6.80	-3.97	6.08	1.28	2.37	0.12	.526
7.00	-3.70	5.57	1.22	2.28	0.12	.517
7.20	-3.42	5.09	1.16	2.19	0.14	.509
7.40	-3.08	4.67	1.12	2.08	0.15	.493
7.60	-2.67	4.44	1.12	1.98	0.17	.464
7.80	-2.55	4.16	1.08	1.93	0.17	.463

Re $\hat{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im($-1/\tilde{\epsilon}$)	$R(\phi=0)$
8.00	-2.24	3.84	1.05	1.83	0.19	.443
8.20	-1.91	3.64	1.05	1.74	0.22	.419
8.40	-1.66	3.49	1.05	1.66	0.23	.397
8.60	-1.39	3.36	1.06	1.58	0.25	.372
8.80	-1.16	3.26	1.07	1.52	0.27	.351
9.00	-0.92	3.18	1.09	1.46	0.29	.327
9.20	-0.74	3.13	1.11	1.41	0.30	.309
9.40	-0.55	3.09	1.14	1.36	0.31	.290
9.60	-0.36	3.06	1.17	1.31	0.32	.273
9.80	-0.19	3.06	1.20	1.27	0.33	.258
10.00	-0.01	3.08	1.24	1.24	0.33	.244
10.20	0.16	3.14	1.29	1.22	0.32	.234
10.40	0.27	3.27	1.33	1.23	0.30	.233
10.60	0.29	3.42	1.36	1.25	0.29	.238
10.80	0.25	3.53	1.38	1.28	0.28	.245
11.00	0.17	3.60	1.37	1.31	0.28	.253
11.20	0.07	3.61	1.36	1.33	0.28	.259
11.40	-0.02	3.57	1.33	1.34	0.28	.264
11.60	-0.09	3.50	1.31	1.34	0.29	.266
11.80	-0.14	3.42	1.28	1.33	0.29	.266
12.00	-0.16	3.32	1.26	1.32	0.30	.264
12.20	-0.14	3.24	1.25	1.30	0.31	.260
12.40	-0.13	3.18	1.23	1.29	0.31	.257
12.60	-0.11	3.11	1.23	1.27	0.32	.254
12.80	-0.10	3.07	1.22	1.26	0.33	.251
13.00	-0.08	3.02	1.21	1.25	0.33	.248
13.20	-0.07	2.96	1.20	1.23	0.34	.245
13.40	-0.04	2.90	1.20	1.21	0.34	.240
13.60	-0.01	2.86	1.19	1.20	0.35	.236
13.80	0.03	2.82	1.19	1.18	0.36	.231
14.00	0.08	2.78	1.20	1.16	0.36	.225
14.20	0.14	2.76	1.21	1.14	0.36	.219
14.40	0.21	2.76	1.22	1.13	0.36	.214
14.60	0.28	2.78	1.24	1.12	0.36	.210
14.80	0.35	2.84	1.27	1.12	0.35	.207
15.00	0.38	2.94	1.29	1.14	0.33	.210
15.20	0.35	3.06	1.31	1.17	0.32	.218
15.40	0.28	3.14	1.31	1.20	0.32	.226
15.60	0.21	3.21	1.31	1.23	0.31	.234
15.80	0.09	3.26	1.29	1.26	0.31	.244
16.00	0.00	3.27	1.28	1.28	0.31	.251
16.20	-0.10	3.29	1.26	1.30	0.30	.259
16.40	-0.25	3.30	1.24	1.33	0.30	.270
16.60	-0.38	3.26	1.21	1.35	0.30	.280
16.80	-0.49	3.20	1.17	1.37	0.31	.298
17.60	-0.87	2.85	1.03	1.39	0.32	.320
17.00	-0.61	3.15	1.14	1.38	0.31	.297
17.20	-0.73	3.07	1.10	1.39	0.31	.307
17.40	-0.82	2.96	1.06	1.39	0.31	.314
17.80	-0.94	2.75	0.99	1.39	0.33	.327
18.00	-1.00	2.64	0.95	1.38	0.33	.334
18.20	-1.04	2.52	0.92	1.37	0.34	.340
18.40	-1.07	2.41	0.88	1.36	0.35	.346
18.60	-1.09	2.29	0.85	1.35	0.36	.351
18.80	-1.10	2.17	0.82	1.33	0.37	.355
19.00	-1.10	2.06	0.79	1.31	0.38	.357
19.20	-1.08	1.96	0.76	1.29	0.39	.360

Re $\hat{E}\perp\hat{c}$

Energy (eV)	ϵ_1	ϵ_2	n	k	Im($-1/\tilde{\epsilon}$)	$R(\phi=0)$
19.40	-1.06	1.87	0.74	1.27	0.40	.361
19.60	-1.04	1.79	0.72	1.25	0.42	.363
19.80	-1.02	1.71	0.70	1.23	0.43	.364
20.00	-1.01	1.61	0.67	1.21	0.45	.369
20.20	-0.95	1.54	0.65	1.17	0.47	.365
20.40	-0.92	1.47	0.64	1.15	0.49	.364
20.80	-0.84	1.35	0.61	1.10	0.53	.357
21.20	-0.76	1.26	0.60	1.06	0.58	.349
21.60	-0.70	1.19	0.58	1.02	0.63	.342
22.00	-0.64	1.12	0.57	0.98	0.67	.336
22.40	-0.58	1.06	0.56	0.95	0.72	.328
22.80	-0.55	1.00	0.55	0.92	0.77	.325
23.20	-0.51	0.94	0.53	0.89	0.82	.322
23.60	-0.46	0.88	0.52	0.85	0.89	.317
24.00	-0.42	0.83	0.50	0.82	0.96	.314
24.40	-0.38	0.78	0.49	0.79	1.04	.309
24.80	-0.34	0.72	0.48	0.75	1.14	.303
25.20	-0.29	0.68	0.47	0.72	1.25	.295
25.60	-0.25	0.63	0.47	0.68	1.37	.286
26.00	-0.20	0.60	0.46	0.64	1.51	.276
26.40	-0.16	0.56	0.46	0.61	1.66	.263
26.80	-0.11	0.53	0.46	0.57	1.82	.249
27.20	-0.06	0.50	0.47	0.53	1.96	.231
27.60	-0.03	0.48	0.48	0.50	2.08	.216
28.00	0.02	0.46	0.49	0.47	2.17	.198
29.00	0.10	0.42	0.51	0.41	2.28	.164
30.00	0.18	0.38	0.55	0.34	2.17	.129
31.00	0.26	0.35	0.59	0.29	1.83	.097
32.00	0.34	0.33	0.64	0.26	1.47	.072
32.50	0.36	0.33	0.65	0.25	1.37	.066
33.00	0.39	0.32	0.67	0.24	1.27	.060
34.00	0.44	0.31	0.70	0.22	1.05	.047
35.00	0.50	0.30	0.74	0.20	0.88	.036
36.00	0.56	0.30	0.77	0.19	0.75	.029
37.00	0.61	0.30	0.80	0.19	0.65	.023
38.00	0.67	0.32	0.84	0.19	0.58	.018
39.00	0.73	0.36	0.88	0.21	0.55	.016
40.00	0.70	0.44	0.87	0.25	0.65	.023
41.00	0.69	0.44	0.87	0.25	0.66	.023
42.00	0.70	0.44	0.87	0.25	0.65	.023
43.00	0.71	0.46	0.88	0.26	0.65	.023
44.00	0.70	0.50	0.88	0.28	0.68	.026
45.00	0.66	0.53	0.87	0.31	0.74	.031
46.00	0.62	0.53	0.84	0.31	0.80	.035
47.00	0.59	0.50	0.83	0.31	0.84	.036
48.00	0.58	0.49	0.82	0.30	0.85	.036
49.00	0.56	0.48	0.81	0.30	0.87	.037
50.00	0.55	0.47	0.80	0.30	0.90	.039
51.00	0.53	0.47	0.79	0.30	0.93	.040
52.00	0.50	0.46	0.77	0.30	0.99	.044
53.00	0.47	0.45	0.75	0.30	1.05	.048
54.00	0.43	0.42	0.71	0.29	1.19	.055
55.00	0.39	0.37	0.69	0.27	1.27	.060
56.00	0.38	0.31	0.66	0.23	1.29	.061
57.00	0.38	0.25	0.65	0.20	1.22	.060
58.00	0.39	0.20	0.64	0.16	1.04	.055
59.00	0.41	0.16	0.65	0.17	0.81	.050

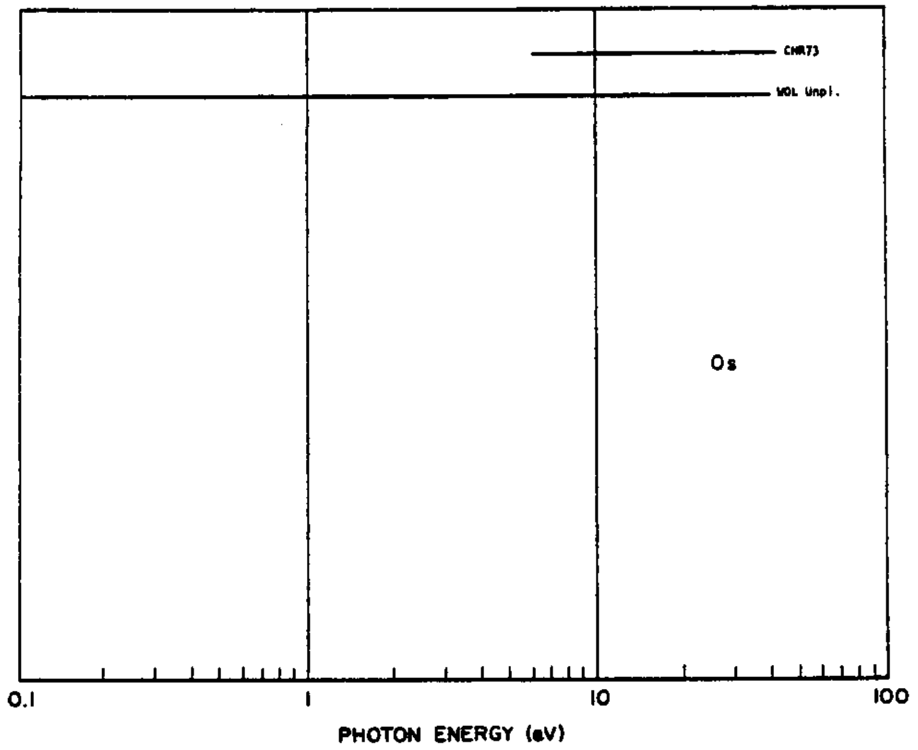

Fig. 89 Survey of available data for Os

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Os
CHR73	6.2-41.3	m-θ		x			Ex	R,n,k,ε_1,ε_2	table of λ,n,k
WOL Unpl	0.1-40	Refl	4.2 K for hν < 4.4 eV RT for hν > 4.4 eV			x	EP	R; KK: n,k,ε_1,ε_2	absorption measured by calorimetry for hν < 4.4 eV, reflectivity measured for hν > 4.4 eV with synchrotron radiation

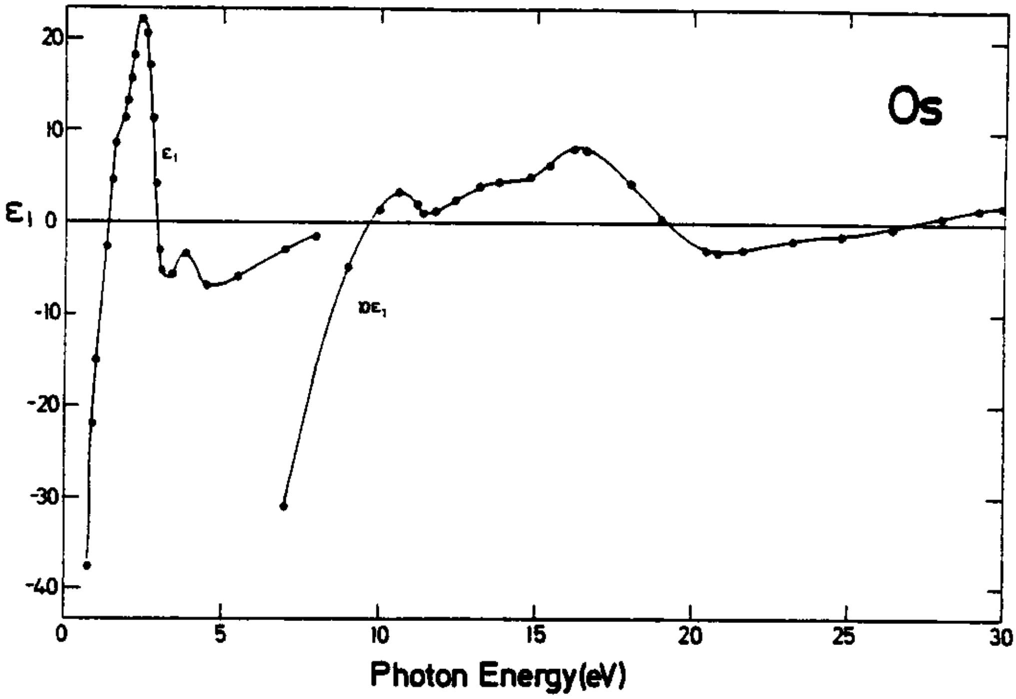

Fig. 91 ε_1 for polycrystalline Os reported by LOW (unpub).

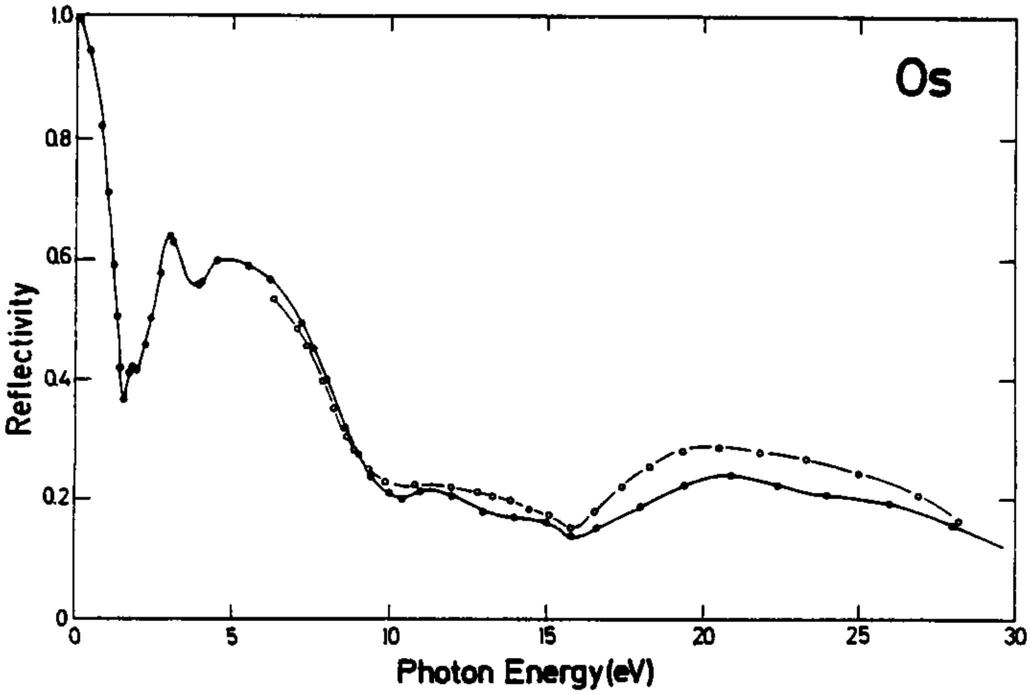

Fig. 90 Reflectivity of polycrystalline Os. •-•- LOW (unpub); o-o CHR73.

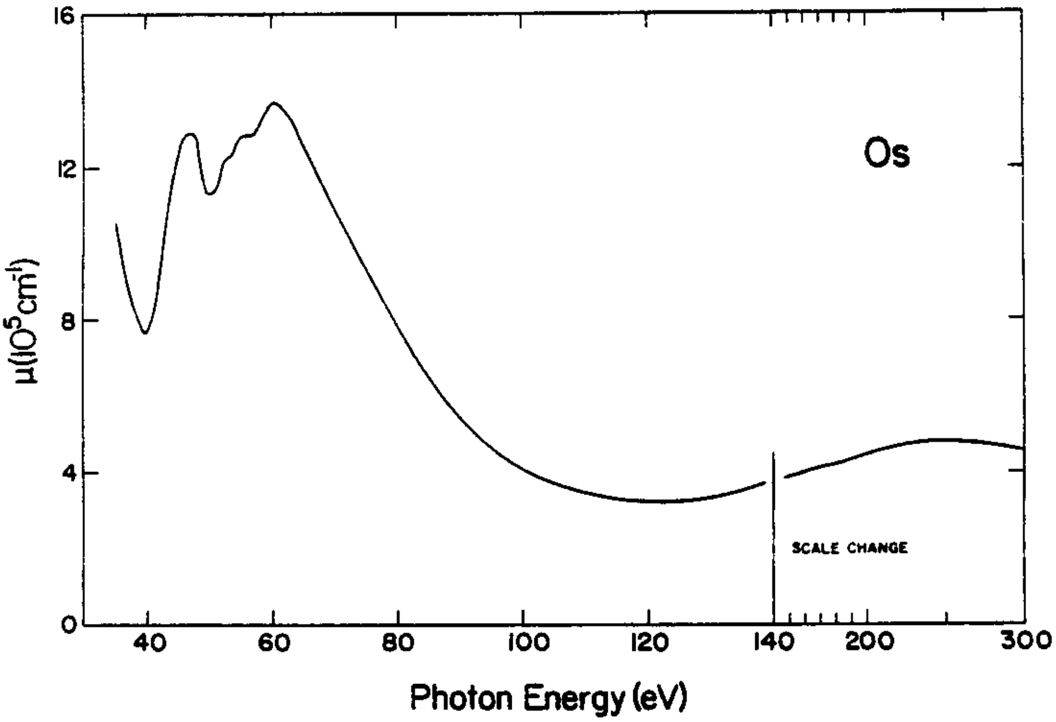

Fig. 93 Absorption coefficient for Os reported by Leyser 1972.

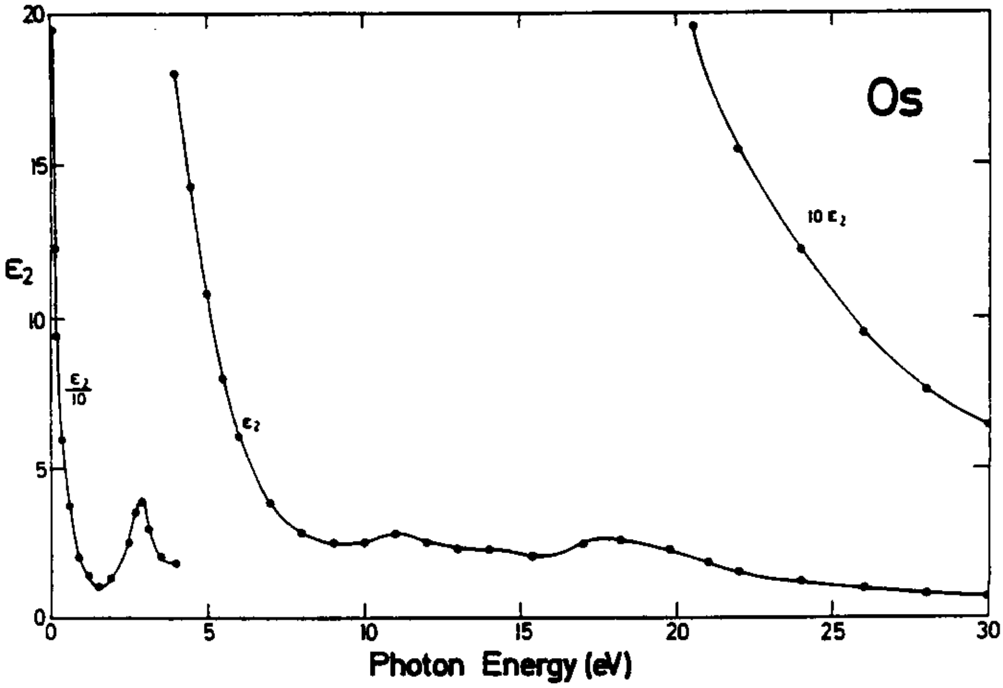

Fig. 92 ϵ_2 for polycrystalline Os reported by LOW (unpub).

Polycrystalline Osmium

D.W. Lynch, C.G. Olson, and J.H. Weaver (unpub)

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε̃)	R(ϕ=0)
0.10	-2506.77	409.56	4.08	50.23	0.00	.994
0.15	-1120.81	195.24	2.90	33.60	0.00	.990
0.20	-624.50	122.81	2.44	25.11	0.00	.985
0.25	-394.03	93.75	2.35	19.99	0.00	.977
0.30	-268.65	73.93	2.23	16.54	0.00	.969
0.35	-192.38	65.60	2.33	14.06	0.00	.955
0.40	-145.71	60.31	2.45	12.32	0.00	.940
0.45	-115.54	53.62	2.43	11.02	0.00	.927
0.50	-93.62	47.99	2.41	9.97	0.00	.913
0.55	-77.73	42.47	2.33	9.12	0.01	.901
0.60	-65.21	37.02	2.21	8.37	0.01	.890
0.65	-54.58	32.33	2.11	7.68	0.01	.877
0.70	-45.50	28.50	2.02	7.04	0.01	.862
0.75	-37.69	25.88	2.00	6.46	0.01	.842
0.80	-31.44	23.86	2.00	5.95	0.02	.820
0.85	-26.30	22.11	2.01	5.51	0.02	.796
0.90	-21.89	20.70	2.03	5.10	0.02	.769
0.95	-18.24	19.45	2.05	4.74	0.03	.742
1.00	-15.08	18.38	2.09	4.41	0.03	.712
1.05	-12.41	17.42	2.12	4.11	0.04	.682
1.10	-10.13	16.50	2.15	3.84	0.04	.651
1.15	-8.16	15.58	2.17	3.59	0.05	.621
1.20	-6.53	14.43	2.16	3.35	0.06	.592
1.25	-4.45	13.31	2.19	3.04	0.07	.549
1.30	-2.59	12.43	2.25	2.77	0.08	.506
1.35	-0.61	11.65	2.35	2.48	0.09	.458
1.40	1.23	11.10	2.49	2.23	0.09	.419
1.45	3.00	10.63	2.65	2.01	0.09	.389
1.50	4.84	10.24	2.84	1.80	0.08	.369
1.53	6.08	10.18	2.99	1.70	0.07	.364
1.57	7.62	10.48	3.21	1.63	0.06	.370
1.60	8.67	10.92	3.36	1.62	0.06	.379
1.65	9.96	11.88	3.57	1.66	0.05	.396
1.70	10.66	12.92	3.70	1.75	0.05	.411
1.75	10.89	13.54	3.76	1.80	0.04	.419
1.80	10.96	13.88	3.78	1.83	0.04	.423
1.85	11.07	13.68	3.79	1.81	0.04	.421
1.90	11.50	13.32	3.81	1.75	0.04	.418
1.95	12.24	12.93	3.88	1.67	0.04	.416
2.00	13.29	12.74	3.98	1.60	0.04	.416
2.05	14.48	12.83	4.11	1.56	0.03	.424
2.10	15.75	13.07	4.26	1.54	0.03	.432
2.15	17.15	13.77	4.42	1.56	0.03	.444
2.20	18.31	14.86	4.59	1.62	0.03	.457
2.25	19.21	15.79	4.69	1.68	0.03	.467
2.30	20.29	17.03	4.84	1.76	0.02	.479
2.35	21.26	18.64	4.98	1.87	0.02	.493
2.40	21.94	20.52	5.10	2.01	0.02	.506
2.45	22.35	22.87	5.22	2.19	0.02	.520

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε̃)	R(ϕ=0)
2.50	22.25	25.14	5.28	2.38	0.02	.532
2.60	20.82	30.22	5.36	2.82	0.02	.557
2.70	17.25	34.85	5.30	3.29	0.02	.580
2.80	11.44	38.35	5.07	3.78	0.02	.603
2.90	4.11	38.90	4.65	4.18	0.03	.624
2.95	0.48	37.75	4.37	4.32	0.03	.632
3.00	-2.97	35.62	4.05	4.40	0.03	.639
3.05	-4.90	32.41	3.73	4.34	0.03	.638
3.10	-5.38	29.52	3.51	4.21	0.03	.631
3.15	-5.26	27.42	3.37	4.07	0.04	.622
3.20	-4.85	26.04	3.29	3.96	0.04	.614
3.25	-4.89	25.24	3.23	3.91	0.04	.611
3.30	-5.17	24.42	3.15	3.88	0.04	.610
3.35	-5.61	23.43	3.04	3.85	0.04	.610
3.40	-5.79	22.18	2.93	3.79	0.04	.607
3.45	-5.58	20.96	2.84	3.69	0.04	.600
3.50	-5.11	20.09	2.79	3.59	0.05	.591
3.60	-4.35	19.02	2.75	3.45	0.05	.577
3.70	-3.88	18.43	2.73	3.37	0.05	.568
3.80	-3.55	18.10	2.73	3.32	0.05	.562
3.90	-3.51	18.03	2.73	3.31	0.05	.561
4.00	-3.80	18.07	2.71	3.34	0.05	.565
4.10	-4.62	17.96	2.64	3.40	0.05	.575
4.20	-5.46	17.43	2.53	3.44	0.05	.584
4.30	-6.35	16.57	2.39	3.47	0.05	.594
4.40	-6.84	15.41	2.24	3.44	0.05	.599
4.50	-6.99	14.28	2.11	3.38	0.06	.600
4.60	-6.91	13.31	2.01	3.31	0.06	.599
4.70	-6.72	12.56	1.94	3.24	0.06	.594
4.80	-6.62	11.98	1.88	3.19	0.06	.592
4.90	-6.64	11.44	1.82	3.15	0.07	.593
5.00	-6.71	10.82	1.74	3.12	0.07	.596
5.10	-6.70	10.12	1.65	3.07	0.07	.599
5.20	-6.51	9.48	1.58	3.00	0.07	.597
5.30	-6.34	8.93	1.52	2.94	0.07	.595
5.40	-6.17	8.44	1.46	2.88	0.08	.593
5.50	-5.99	7.97	1.41	2.83	0.08	.591
5.60	-5.81	7.52	1.36	2.77	0.08	.589
5.70	-5.59	7.12	1.32	2.71	0.09	.585
5.80	-5.40	6.76	1.27	2.65	0.09	.582
5.90	-5.20	6.43	1.24	2.60	0.09	.578
6.00	-5.03	6.12	1.20	2.54	0.10	.575
6.20	-4.70	5.49	1.13	2.44	0.11	.571
6.40	-4.30	4.93	1.06	2.33	0.12	.557
6.60	-3.89	4.47	1.01	2.21	0.13	.548
6.80	-3.48	4.10	0.97	2.11	0.14	.532
7.00	-3.11	3.80	0.95	2.00	0.16	.514
7.20	-2.79	3.52	0.92	1.91	0.17	.497
7.40	-2.46	3.28	0.91	1.81	0.19	.475
7.60	-2.14	3.09	0.90	1.72	0.22	.451
7.80	-1.85	2.94	0.90	1.63	0.24	.426
8.00	-1.59	2.82	0.91	1.55	0.27	.400
8.20	-1.35	2.70	0.91	1.48	0.30	.376
8.40	-1.05	2.62	0.94	1.40	0.33	.343
8.60	-0.88	2.57	0.96	1.34	0.35	.319
8.80	-0.69	2.53	0.98	1.29	0.37	.298
9.00	-0.50	2.50	1.01	1.24	0.38	.276

Os

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
9.20	-0.34	2.48	1.04	1.19	0.40	.255
9.40	-0.18	2.49	1.08	1.16	0.40	.238
9.60	-0.08	2.52	1.10	1.14	0.40	.229
9.80	0.04	2.52	1.13	1.11	0.40	.217
10.00	0.14	2.54	1.16	1.10	0.39	.209
10.20	0.23	2.57	1.19	1.08	0.39	.203
10.30	0.28	2.60	1.20	1.08	0.38	.201
10.40	0.32	2.63	1.22	1.08	0.37	.200
10.50	0.34	2.68	1.23	1.09	0.37	.201
10.60	0.34	2.72	1.24	1.10	0.36	.203
10.80	0.32	2.78	1.25	1.11	0.36	.206
11.00	0.26	2.81	1.24	1.13	0.35	.213
11.20	0.20	2.81	1.23	1.14	0.35	.217
11.40	0.09	2.75	1.19	1.15	0.36	.223
11.60	0.10	2.62	1.17	1.12	0.38	.216
11.80	0.12	2.55	1.16	1.10	0.39	.211
12.00	0.15	2.48	1.15	1.08	0.40	.205
12.20	0.19	2.41	1.14	1.06	0.41	.199
12.40	0.25	2.36	1.14	1.03	0.42	.191
12.60	0.29	2.34	1.15	1.02	0.42	.186
12.80	0.32	2.32	1.15	1.01	0.42	.183
13.00	0.36	2.29	1.16	0.99	0.43	.178
13.20	0.40	2.28	1.16	0.98	0.43	.174
13.40	0.42	2.27	1.17	0.97	0.43	.172
13.60	0.44	2.27	1.17	0.97	0.42	.170
13.80	0.46	2.26	1.18	0.96	0.42	.169
14.00	0.45	2.26	1.17	0.96	0.43	.169
14.20	0.44	2.23	1.17	0.96	0.43	.168
14.40	0.45	2.19	1.16	0.94	0.44	.165
14.60	0.47	2.15	1.15	0.93	0.44	.161
14.80	0.50	2.11	1.16	0.91	0.45	.156
15.00	0.55	2.09	1.16	0.90	0.45	.151
15.20	0.59	2.08	1.17	0.89	0.45	.148
15.40	0.63	2.07	1.18	0.87	0.44	.144
15.60	0.70	2.07	1.20	0.86	0.43	.140
15.80	0.76	2.09	1.22	0.86	0.42	.138
16.00	0.80	2.15	1.25	0.87	0.41	.140
16.20	0.83	2.22	1.26	0.88	0.40	.142
16.40	0.82	2.29	1.28	0.90	0.39	.147
16.60	0.80	2.35	1.28	0.92	0.38	.152
16.80	0.77	2.40	1.28	0.94	0.38	.157
17.00	0.72	2.45	1.28	0.96	0.39	.162
17.20	0.68	2.48	1.27	0.97	0.37	.167
17.40	0.63	2.52	1.27	0.99	0.37	.172
17.60	0.56	2.55	1.26	1.01	0.37	.178
17.80	0.49	2.56	1.24	1.03	0.38	.184
18.00	0.42	2.57	1.23	1.04	0.38	.189
18.20	0.35	2.57	1.21	1.06	0.38	.194
18.40	0.27	2.56	1.19	1.08	0.39	.200
18.60	0.19	2.54	1.17	1.09	0.39	.205
18.80	0.11	2.51	1.14	1.10	0.40	.210
19.00	0.05	2.46	1.12	1.10	0.41	.214
19.20	-0.02	2.42	1.10	1.10	0.41	.219
19.40	-0.08	2.37	1.07	1.11	0.42	.223
19.60	-0.13	2.32	1.05	1.11	0.43	.227
19.80	-0.19	2.26	1.02	1.11	0.44	.231
20.20	-0.25	2.11	0.96	1.10	0.47	.239

Os

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(φ=0)
20.40	-0.31	2.03	0.93	1.09	0.48	.240
20.60	-0.32	1.95	0.91	1.07	0.50	.241
20.80	-0.32	1.88	0.89	1.05	0.52	.240
21.00	-0.31	1.81	0.87	1.04	0.54	.238
21.20	-0.31	1.75	0.86	1.02	0.55	.237
21.60	-0.30	1.64	0.83	0.99	0.59	.235
22.00	-0.28	1.55	0.80	0.96	0.63	.230
22.40	-0.25	1.46	0.78	0.93	0.66	.226
22.80	-0.22	1.39	0.77	0.90	0.70	.220
23.20	-0.21	1.33	0.75	0.88	0.74	.217
23.60	-0.18	1.27	0.75	0.86	0.77	.211
24.00	-0.17	1.22	0.73	0.84	0.80	.209
24.40	-0.15	1.17	0.72	0.82	0.84	.207
24.80	-0.14	1.11	0.70	0.80	0.88	.205
25.20	-0.12	1.06	0.69	0.77	0.93	.202
25.60	-0.11	1.00	0.67	0.75	0.99	.199
26.00	-0.09	0.95	0.66	0.72	1.05	.195
26.40	-0.06	0.89	0.65	0.69	1.11	.189
26.80	-0.03	0.84	0.63	0.66	1.19	.183
27.20	0.03	0.81	0.65	0.62	1.24	.165
28.00	0.06	0.76	0.64	0.59	1.30	.156
28.40	0.09	0.73	0.64	0.57	1.35	.148
28.80	0.12	0.71	0.65	0.55	1.37	.140
29.20	0.14	0.69	0.65	0.53	1.40	.134
29.60	0.16	0.66	0.65	0.51	1.42	.128
30.00	0.19	0.64	0.65	0.49	1.43	.121
31.00	0.22	0.59	0.65	0.45	1.48	.111
32.00	0.27	0.54	0.66	0.41	1.47	.095
33.00	0.33	0.50	0.68	0.37	1.39	.079
34.00	0.38	0.47	0.70	0.34	1.29	.068
35.00	0.42	0.45	0.72	0.31	1.18	.057
36.00	0.47	0.43	0.74	0.29	1.05	.049
37.00	0.51	0.42	0.77	0.27	0.96	.040
38.00	0.55	0.42	0.79	0.26	0.87	.035
39.00	0.59	0.41	0.81	0.26	0.80	.031
40.00	0.64	0.43	0.84	0.26	0.72	.026

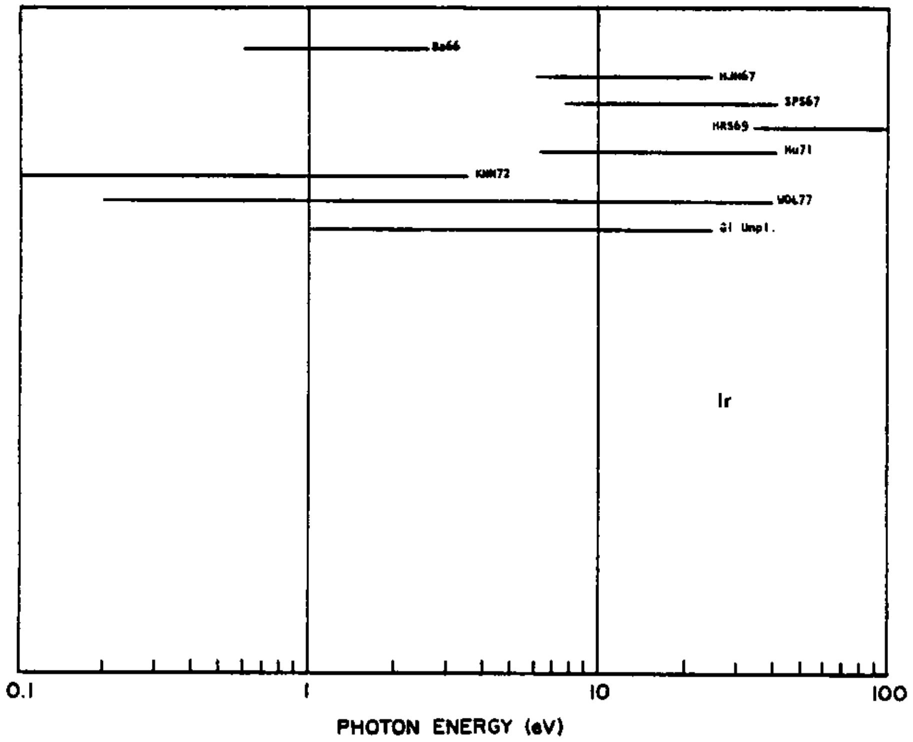

Fig. 94 Survey of available data for Ir

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Ir
				Film	X-tal	Bulk	Prep		
Ba66	0.6-2.6	Ellips	300-2400			x	Heat	n,k	filaments at various temperatures
HJH67	6.2-24.8	m-θ		x			Ex	R,n,k	various substrate temperatures
SPS67	~7.7-41	Trans, Refl		x			Ex	R,T	laser-evaporated films
HRS69	35-300	Trans		x			Ex	μ	optical absorption measurements with synchrotron radiation
Hu71	~6.3-41	Refl		x			Ex	R	
KNN72	0.08-4.08	Ellips	77, 295			x	Ex	$n,k,\varepsilon_1,\varepsilon_2,\sigma$	MP and annealing at ~925 K $\sim 10^{-6}$ Torr
We75									discussion paper
WOL77	0.2-40	Refl	4.2 for $h\nu < 4.4$ eV 300 for $h\nu > 4.4$ eV			x	Ex	R; KK: $\varepsilon_1,\varepsilon_2,\sigma$, $\mathrm{Im}(\varepsilon^{-1}), \mathrm{Im}(\varepsilon+1)^{-1}$	absorptivity measured by calorimetry for $h\nu < 4.4$ eV, reflectivity measured for $h\nu > 4.4$ eV with synchrotron radiation, sample boiled in aqua regia, heated in vacuo $\sim 10^{-7}$ Torr
Gl Unpl	~1-25	m-θ				x	Heat	$R,\varepsilon_1,\varepsilon_2,n,k,\mathrm{Im}(\varepsilon^{-1}), \mathrm{Im}(\varepsilon+1)^{-1}$	studies done at 2×10^{-9} Torr

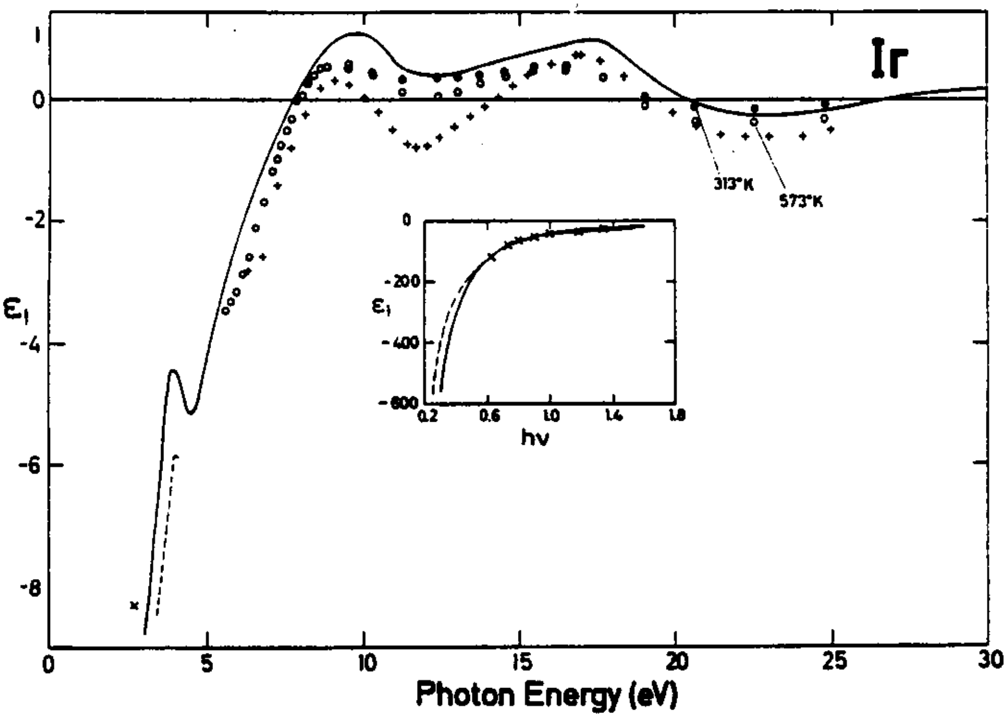

Fig. 96 ε_1 for Ir. —— WOL77; --- KNN72; +++ GI (unpub); xxx Ba66; ●●● and ooo HJH67.

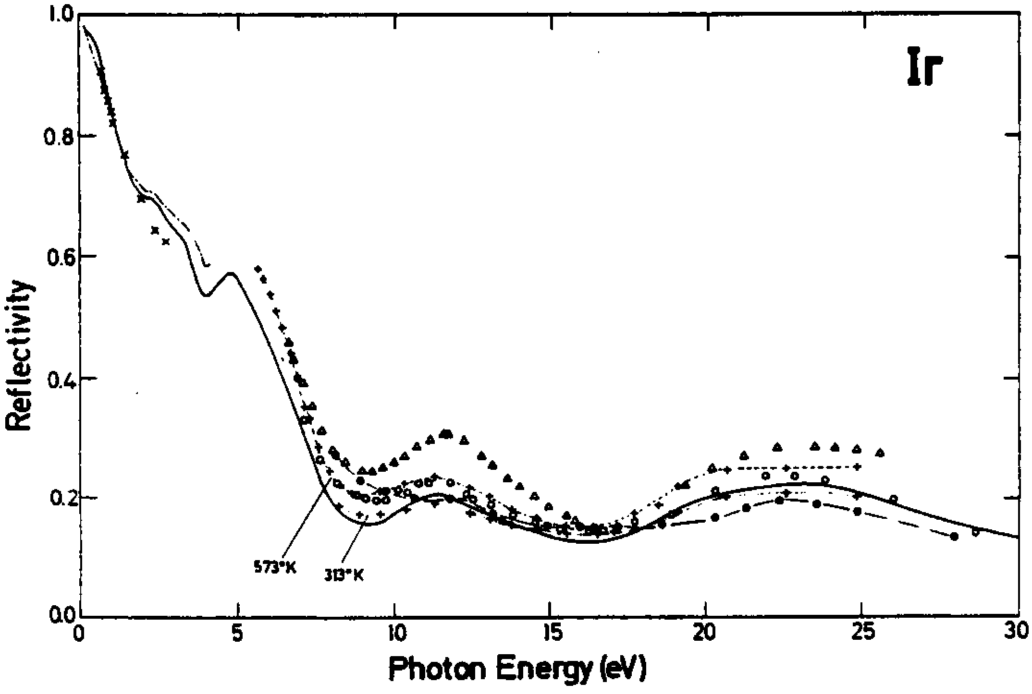

Fig. 95. Reflectivity of Ir. —— WOL77; +++ HJH67; ooo Hu71; ΔΔΔ GI (unpub); ●●● SPS67; xxx Ba66; — - — MNN72; The results of HJH67 show the effect of substrate temperature on the vuv reflectivity.

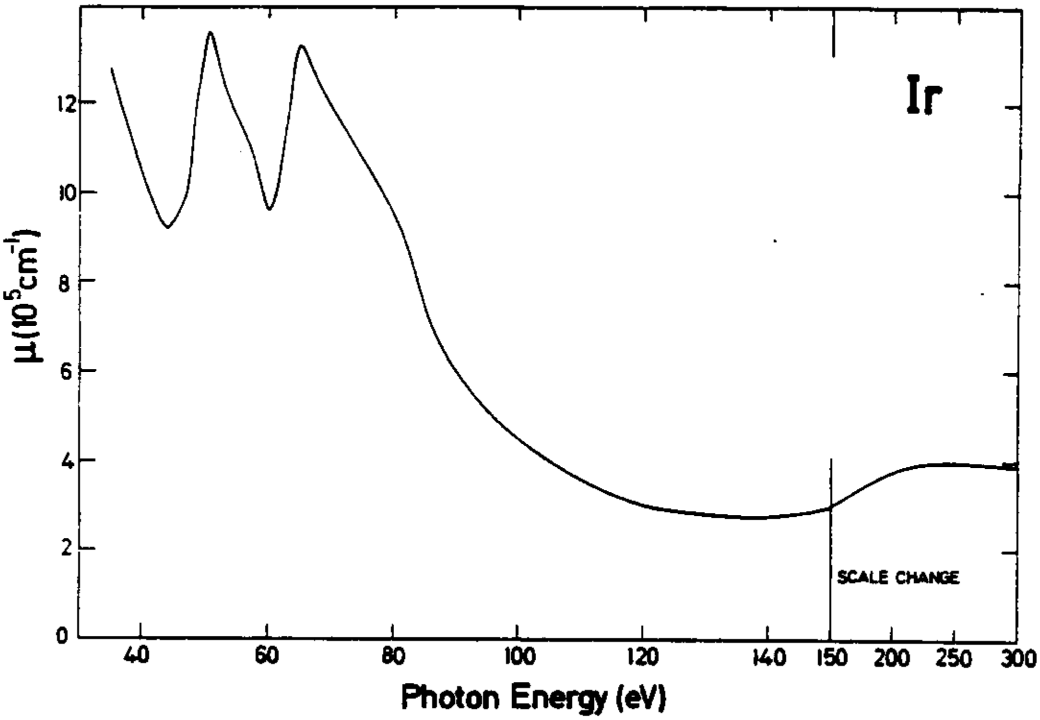

Fig. 98 Absorption coefficient for Ir by HRS69.

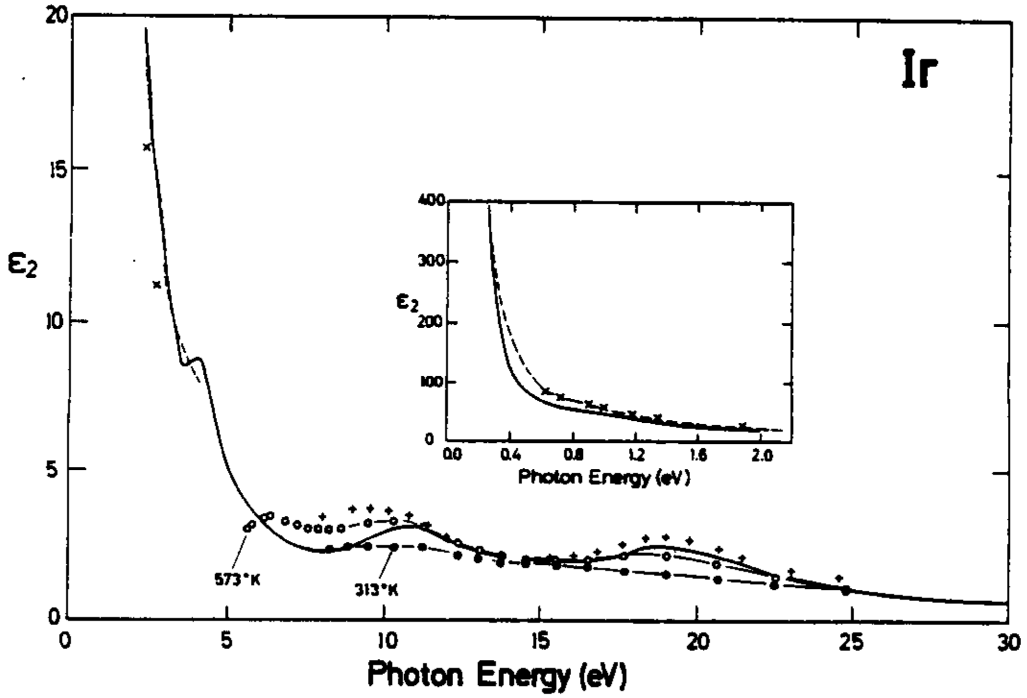

Fig. 97 ϵ_2 for Ir. —— WOL77; +++ GI (unpub); xxx Ba66; --- KNN72; ●●● and ooo HJH67.

Iridium

publication by J.H. Weaver, C.G. Olson, and D.W. Lynch in Phys. Rev. B 4115 (1977) based on the following tabulation

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(φ=0)
0.10	-2863.28	3454.30	28.49	60.62	0.00	.975
0.15	-1803.22	1383.59	15.32	45.15	0.00	.973
0.20	-1154.96	684.50	9.69	35.34	0.00	.972
0.25	-784.80	394.84	6.85	28.84	0.00	.969
0.30	-561.50	250.49	5.16	24.25	0.00	.967
0.35	-415.50	170.77	4.11	20.79	0.00	.964
0.40	-314.40	123.53	3.42	18.06	0.00	.960
0.45	-241.09	96.36	3.05	15.82	0.00	.954
0.50	-188.67	83.67	2.98	14.06	0.00	.944
0.60	-126.33	64.50	2.79	11.58	0.00	.925
0.70	-87.00	57.20	2.93	9.78	0.01	.895
0.80	-64.17	54.12	3.14	8.61	0.01	.862
0.90	-51.92	50.21	3.19	7.88	0.01	.840
1.00	-43.51	46.03	3.15	7.31	0.01	.822
1.10	-37.61	41.59	3.04	6.84	0.01	.808
1.20	-32.32	37.96	2.96	6.41	0.02	.791
1.30	-28.72	34.63	2.85	6.07	0.02	.779
1.40	-25.51	31.26	2.72	5.74	0.02	.767
1.50	-22.05	28.53	2.65	5.39	0.02	.750
1.60	-18.66	27.21	2.68	5.08	0.02	.728
1.70	-17.00	26.46	2.69	4.92	0.03	.716
1.80	-16.15	25.36	2.64	4.81	0.03	.710
1.90	-15.34	24.06	2.57	4.68	0.03	.704
2.00	-14.68	22.84	2.50	4.57	0.03	.699
2.10	-14.33	21.53	2.40	4.48	0.03	.697
2.20	-13.93	20.06	2.29	4.38	0.03	.695
2.30	-13.42	18.60	2.18	4.26	0.04	.692
2.40	-12.88	17.11	2.07	4.14	0.04	.689
2.50	-12.07	15.78	1.98	4.00	0.04	.682
2.60	-11.23	14.74	1.91	3.86	0.04	.673
2.70	-10.53	13.82	1.85	3.73	0.05	.665
2.80	-9.79	13.07	1.81	3.61	0.05	.655
2.90	-9.19	12.47	1.77	3.51	0.05	.646
3.00	-8.76	11.88	1.73	3.43	0.05	.640
3.10	-8.39	11.23	1.68	3.35	0.06	.635
3.20	-7.97	10.56	1.62	3.26	0.06	.629
3.30	-7.49	9.90	1.57	3.15	0.06	.621
3.40	-6.94	9.31	1.53	3.05	0.07	.610
3.50	-6.31	8.81	1.50	2.93	0.07	.595
3.60	-5.57	8.55	1.52	2.81	0.08	.573
3.70	-4.97	8.54	1.57	2.72	0.09	.553
3.80	-4.64	8.62	1.61	2.69	0.09	.541
3.90	-4.43	8.73	1.64	2.67	0.09	.535
4.00	-4.46	8.81	1.64	2.68	0.09	.535
4.10	-4.64	8.75	1.62	2.70	0.09	.541
4.20	-4.84	8.52	1.58	2.71	0.09	.549
4.30	-5.02	8.17	1.51	2.70	0.09	.556
4.40	-5.10	7.77	1.45	2.68	0.09	.561
4.50	-5.16	7.28	1.37	2.65	0.09	.567

Energy (eV)	ε_1	ε_2	n	k	Im(-1/ε)	R(φ=0)
4.60	-5.06	6.84	1.31	2.60	0.09	.567
4.70	-5.04	6.36	1.24	2.56	0.10	.572
4.80	-4.83	5.87	1.18	2.49	0.10	.570
4.90	-4.57	5.49	1.13	2.42	0.11	.564
5.00	-4.34	5.16	1.10	2.35	0.11	.559
5.10	-4.09	4.87	1.07	2.29	0.12	.551
5.20	-3.85	4.61	1.04	2.22	0.13	.543
5.30	-3.61	4.38	1.02	2.15	0.14	.533
5.40	-3.37	4.18	1.00	2.09	0.14	.522
5.50	-3.14	4.02	0.99	2.03	0.15	.510
5.60	-2.94	3.86	0.98	1.98	0.16	.499
5.70	-2.74	3.71	0.97	1.92	0.17	.488
5.80	-2.54	3.60	0.96	1.86	0.19	.474
5.90	-2.37	3.52	0.97	1.82	0.20	.461
6.00	-2.26	3.39	0.95	1.78	0.20	.454
6.10	-2.09	3.27	0.94	1.73	0.22	.441
6.20	-1.92	3.17	0.94	1.68	0.23	.427
6.30	-1.78	3.08	0.94	1.63	0.24	.414
6.40	-1.64	2.99	0.94	1.59	0.26	.401
6.50	-1.49	2.92	0.95	1.54	0.27	.387
6.60	-1.37	2.84	0.94	1.50	0.29	.375
6.70	-1.23	2.77	0.95	1.46	0.30	.360
6.80	-1.10	2.71	0.95	1.42	0.32	.345
6.90	-0.97	2.66	0.96	1.38	0.33	.330
7.00	-0.87	2.61	0.97	1.34	0.35	.318
7.10	-0.74	2.56	0.98	1.30	0.36	.302
7.20	-0.64	2.52	0.99	1.27	0.37	.290
7.30	-0.52	2.47	1.00	1.23	0.39	.275
7.40	-0.41	2.45	1.02	1.20	0.40	.262
7.50	-0.33	2.42	1.03	1.18	0.41	.252
7.60	-0.25	2.37	1.03	1.14	0.42	.241
7.70	-0.12	2.31	1.05	1.10	0.43	.225
7.80	0.04	2.30	1.08	1.06	0.44	.208
7.90	0.13	2.32	1.11	1.05	0.43	.201
8.00	0.22	2.32	1.13	1.03	0.43	.191
8.10	0.31	2.34	1.15	1.01	0.42	.185
8.20	0.39	2.35	1.18	1.00	0.41	.179
8.30	0.46	2.37	1.20	0.99	0.41	.175
8.40	0.52	2.38	1.22	0.98	0.40	.171
8.50	0.60	2.39	1.24	0.97	0.39	.167
8.60	0.65	2.41	1.26	0.96	0.39	.164
8.70	0.71	2.43	1.27	0.95	0.38	.162
8.80	0.76	2.45	1.29	0.95	0.37	.160
8.90	0.82	2.47	1.31	0.94	0.36	.158
9.00	0.89	2.50	1.33	0.94	0.36	.157
9.10	0.93	2.54	1.35	0.94	0.35	.158
9.20	0.96	2.58	1.36	0.95	0.34	.159
9.30	0.99	2.62	1.38	0.95	0.33	.160
9.40	1.02	2.65	1.39	0.95	0.33	.161
9.50	1.05	2.69	1.40	0.96	0.32	.161
9.60	1.06	2.74	1.42	0.97	0.32	.163
9.70	1.09	2.80	1.43	0.98	0.31	.166
9.80	1.09	2.85	1.44	0.99	0.31	.169
9.90	1.08	2.89	1.44	1.00	0.30	.172
10.00	1.07	2.94	1.45	1.01	0.30	.175
10.20	1.01	3.03	1.45	1.04	0.30	.182
10.40	0.95	3.07	1.44	1.07	0.30	.187

Ir

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
10.60	0.87	3.12	1.43	1.09	0.30	.193
10.80	0.75	3.15	1.41	1.12	0.30	.200
11.00	0.62	3.12	1.38	1.13	0.31	.206
11.20	0.51	3.05	1.34	1.14	0.32	.208
11.40	0.43	2.96	1.31	1.13	0.33	.208
11.60	0.38	2.96	1.28	1.12	0.34	.206
11.80	0.36	2.76	1.25	1.10	0.36	.203
12.00	0.36	2.67	1.24	1.08	0.37	.199
12.40	0.36	2.53	1.21	1.05	0.39	.191
12.80	0.40	2.39	1.19	1.01	0.41	.181
13.20	0.43	2.30	1.18	0.98	0.42	.173
13.60	0.46	2.21	1.17	0.95	0.43	.165
14.00	0.53	2.12	1.16	0.91	0.44	.155
14.40	0.59	2.07	1.17	0.89	0.45	.147
14.80	0.64	2.04	1.18	0.87	0.45	.142
15.20	0.70	2.01	1.19	0.84	0.44	.136
15.60	0.75	2.00	1.20	0.83	0.44	.133
16.00	0.79	2.01	1.21	0.83	0.43	.131
16.40	0.83	2.01	1.23	0.82	0.42	.129
16.80	0.89	2.04	1.25	0.82	0.41	.127
17.20	0.94	2.13	1.28	0.83	0.39	.131
17.60	0.93	2.26	1.30	0.87	0.38	.140
18.00	0.83	2.40	1.30	0.93	0.37	.154
18.40	0.67	2.47	1.27	0.97	0.38	.166
18.80	0.54	2.48	1.24	1.00	0.39	.176
19.20	0.38	2.47	1.20	1.03	0.40	.187
19.60	0.21	2.42	1.15	1.05	0.41	.197
20.00	0.08	2.32	1.10	1.06	0.43	.205
20.50	-0.03	2.18	1.04	1.05	0.46	.210
21.00	-0.11	2.05	0.99	1.04	0.49	.215
21.50	-0.17	1.92	0.94	1.02	0.52	.220
22.00	-0.21	1.79	0.89	1.00	0.55	.222
22.50	-0.26	1.66	0.84	0.99	0.59	.228
23.00	-0.28	1.52	0.79	0.96	0.64	.232
23.50	-0.26	1.38	0.76	0.92	0.70	.228
24.00	-0.23	1.27	0.73	0.87	0.76	.223
24.50	-0.20	1.17	0.70	0.83	0.83	.218
25.00	-0.16	1.09	0.69	0.79	0.90	.209
25.50	-0.12	1.02	0.68	0.76	0.96	.200
26.00	-0.08	0.96	0.67	0.72	1.03	.192
26.50	-0.03	0.92	0.67	0.69	1.09	.181
27.00	-0.01	0.87	0.66	0.66	1.15	.174
27.50	0.03	0.83	0.66	0.63	1.20	.166
28.00	0.06	0.80	0.66	0.61	1.24	.158
28.50	0.08	0.77	0.66	0.59	1.29	.151
29.00	0.09	0.75	0.65	0.57	1.32	.148
29.50	0.11	0.71	0.64	0.55	1.38	.145
30.00	0.12	0.68	0.64	0.53	1.43	.140
32.00	0.19	0.55	0.62	0.44	1.62	.119
34.00	0.28	0.44	0.64	0.35	1.60	.091
36.00	0.40	0.38	0.69	0.27	1.26	.059
38.00	0.47	0.35	0.73	0.24	1.02	.044
40.00	0.53	0.33	0.76	0.22	0.85	.034

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks
				Film	X-tal	Bulk	Prep		Pt
Sa39	2.6-27.6	Refl		x			Ex	R	
HT59	5.6-21.2	Refl		x			Ex	R	
MC61	6.2-24.8	Trans, Refl		x			In	R	
JMC63	5.6-24.8	Refl		x			In	R,n, and k at λ = 584,735,1216 Å	substrate temperature 373 K
DH64	0.03-5.6	Refl		x			Ex	R	
Ba66	0.6-2.6	Ellips	300-1900			x	Heat	n,k	filaments at various T
LT66	0.06-0.25	Ellips				x	MP	$\epsilon_2/\lambda,\epsilon_1$	
LTA66	0.1-3.5	Ellips				x	MP	$\epsilon_2/\lambda,\epsilon_1$	
Le67	<4	Ellips				x	MP	ϵ_2/λ	data from LT66 and LTA66
JCF68	∿78-∿506	Trans		x			Ex	μ/ρ	soft x-ray absorption
YSH68	0.06-21.2	Refl, m-θ		x			Ex	R; KK: $\epsilon_1,\epsilon_2,\mu$, $\mathrm{Im}(\epsilon^{-1})$	table E,R(θ)
HRH69	6.2-12.4	Refl		x			Ex	R	varied substrates, substrate T, and thickness
Ro70	∿25-∿170	m-θ		x			Ex	R,n,μ	
Hu71	6.2-41.3	Refl		x			Ex	R	
JPT72	∿0.08-∿0.48	Refl				x	Ex	R	

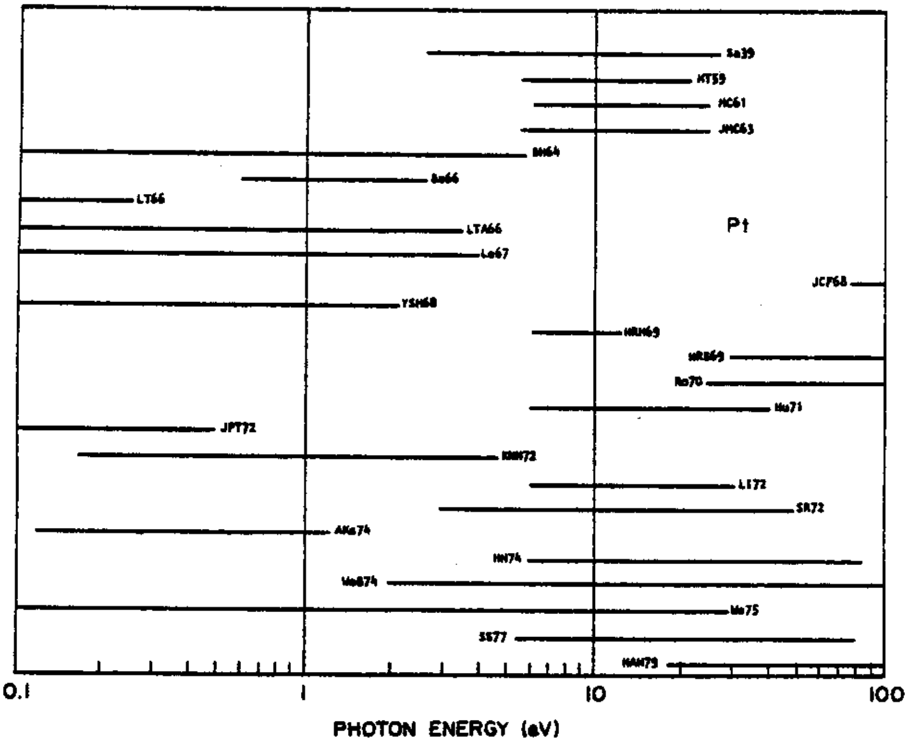

Fig. 99 Survey of available data for Pt

Authors	Energy Range (eV)	Technique	Temperature (K) RT unless specified	Sample				Data Presentation	Remarks Pt
				Film	X-tal	Bulk	Prep		
KNN72	0.17-4.7	Ellips	295, 77			x	Ex	$n,k,R,\varepsilon_1,\varepsilon_2,\sigma$	MP and annealed ~1025 K, 10^{-6} Torr
Li72	6.2-31	m-θ		x			Ex	$R,n,k,\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	
SR72	3-50	Refl		x			Ex	R; KK: $\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1}),$ $\mathrm{Im}(\varepsilon+1)^{-1},\mu$	
Aks74	0.12-1.24		373-773					ε_N	emissivity
HH74	6.2-82.7	Refl		x			Ex	R	substrate temperature 573 K
MSM74			1100-1800					ε at $\lambda = 6450$ Å, $\lambda = 5460$ Å	emissivity
WG74	2-~120	Trans		x			Ex	KK: μ	energy loss spectroscopy, then KK
We75	0.1-30	Refl	4.2			x	EP	R; KK: ε_2	sample boiled in auqa regia; absorptivity measured by calorimetry for $h\nu < 4.88$ eV
ST77	0.05-0.1	Ellips	295		x		MP	$\varepsilon_2/\lambda,\varepsilon_1$	
HAH79	5.6-82.7	m-θ		x			Ex	$R,n,k,\varepsilon_1,\varepsilon_2,\mathrm{Im}(\varepsilon^{-1})$	substrate temperature 313, 573 K; ~10^{-5} Torr
DMW80	0-120	Trans, Refl		x	x	x	In	μ	electron loss spectroscopy and optical absorption with synchrotron radiation

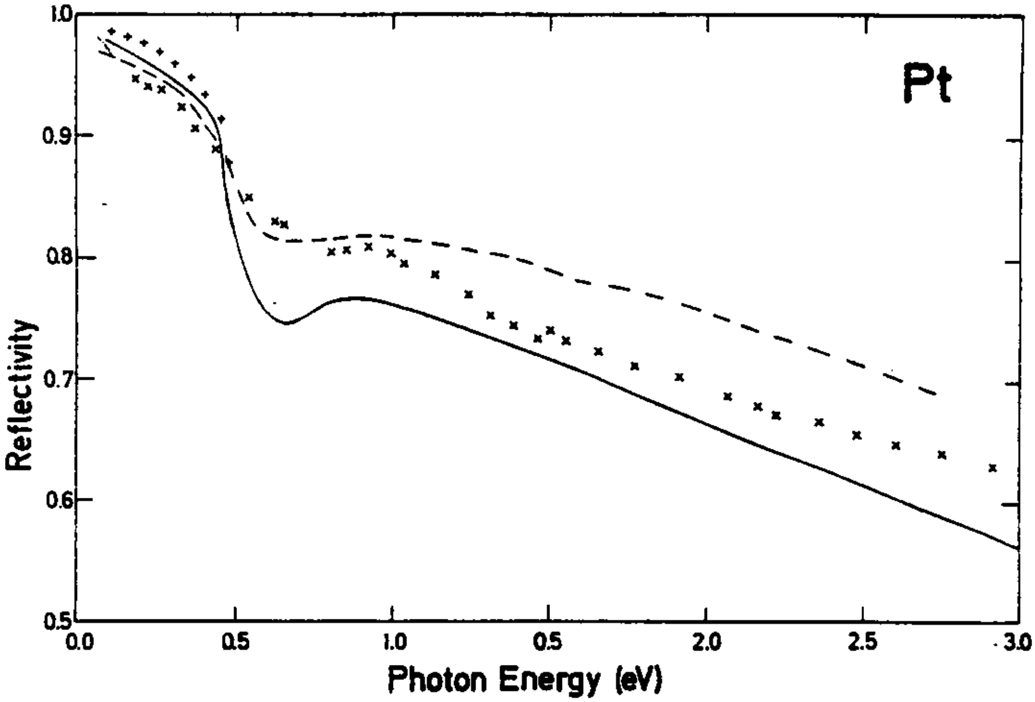

Fig. 101 Reflectivity of Pt for 0 ≤ hν ≤ 3 eV. —— We75; xxx KNN72; +++ JPT72; --- DH64; -·- ST77.

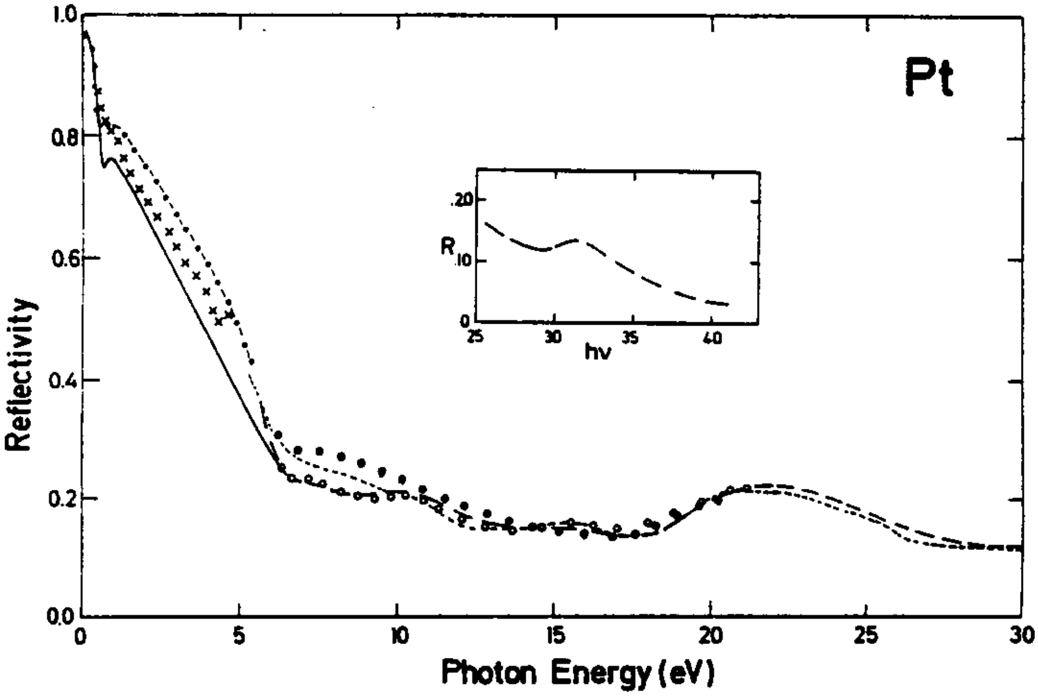

Fig. 100 Reflectivity of Pt. —— We75; xxx KNN72; --- SR72; -·- DH64; ooo YSH68; ●●● JMC63; — — HAH79.

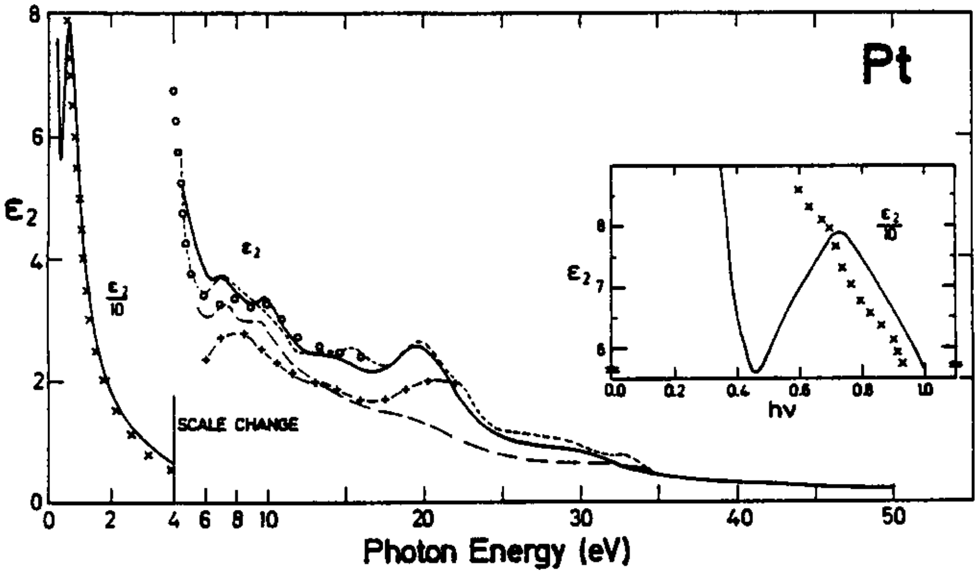

Fig. 103 ε_2 for Pt. —— We75; --- SR72; xxx KNN72; +++ LI72; ooo YSH68; — — HAH79.

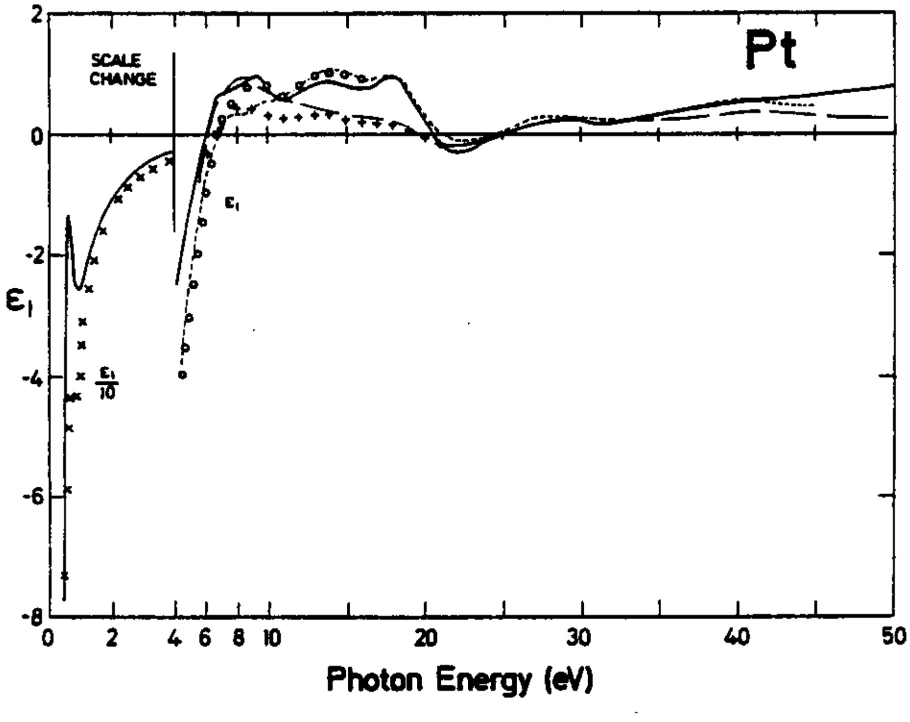

Fig. 102 ε_1 for Pt. —— We75; --- SR72; xxx KNN72; +++ LI72; ooo YSH68; — — HAH79.

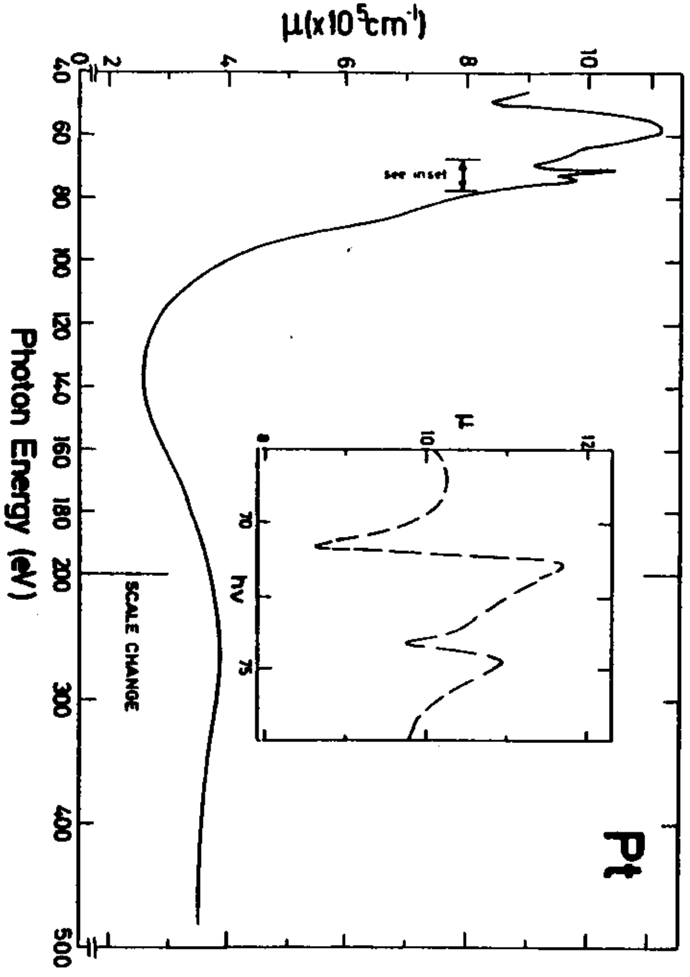

Fig. 104 Absorption coefficient for Pt. —— NRS69. --- (inset) by DW80.

Platinum

publication by J.H. Weaver in Phys. Rev. B 11, 1416 (1975) using results of G. Hass and W.R. Hunter in the VUV based on the following tabulation

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/ε)	R(ϕ=0)
0.10	-1825.31	1181.84	13.21	44.72	0.00	.976
0.13	-1250.94	728.18	9.91	36.73	0.00	.973
0.15	-903.98	509.65	8.18	31.16	0.00	.969
0.17	-691.50	368.54	6.78	27.16	0.00	.966
0.20	-538.86	262.83	5.90	23.95	0.00	.962
0.22	-432.56	224.77	5.24	21.45	0.00	.958
0.25	-354.25	182.48	4.70	19.40	0.00	.954
0.28	-293.87	149.85	4.24	17.66	0.00	.950
0.30	-245.74	126.85	3.92	16.16	0.00	.945
0.32	-208.49	106.27	3.57	14.88	0.00	.941
0.35	-175.95	89.67	3.28	13.66	0.00	.936
0.38	-147.76	75.96	3.03	12.53	0.00	.930
0.40	-121.61	63.92	2.81	11.38	0.00	.922
0.43	-96.56	59.91	2.92	10.25	0.00	.903
0.45	-77.61	56.35	3.03	9.31	0.01	.882
0.47	-59.29	56.47	3.36	8.40	0.01	.850
0.50	-44.21	60.25	3.91	7.71	0.01	.813
0.52	-36.30	63.70	4.30	7.40	0.01	.793
0.55	-30.02	65.46	4.58	7.14	0.01	.777
0.57	-23.88	67.00	4.86	6.89	0.01	.762
0.60	-19.15	69.25	5.13	6.75	0.01	.753
0.63	-16.36	71.60	5.34	6.70	0.01	.749
0.65	-13.90	73.63	5.52	6.66	0.01	.746
0.68	-13.26	76.18	5.66	6.73	0.01	.748
0.70	-14.07	78.05	5.71	6.83	0.01	.751
0.73	-16.08	78.83	5.67	6.95	0.01	.756
0.75	-18.26	78.16	5.57	7.02	0.01	.759
0.77	-19.96	76.62	5.44	7.04	0.01	.761
0.80	-21.44	74.72	5.31	7.04	0.01	.762
0.82	-22.43	72.57	5.17	7.01	0.01	.763
0.85	-23.32	70.47	5.05	6.98	0.01	.763
0.88	-24.16	68.29	4.91	6.95	0.01	.764
0.90	-24.96	65.89	4.77	6.91	0.01	.765
0.95	-25.59	61.02	4.50	6.77	0.01	.763
1.00	-25.79	56.31	4.25	6.62	0.01	.752
1.05	-25.20	51.96	4.03	6.44	0.02	.758
1.10	-24.11	48.15	3.86	6.24	0.02	.753
1.15	-23.29	44.99	3.70	6.08	0.02	.749
1.20	-22.48	42.02	3.55	5.92	0.02	.746
1.30	-20.61	36.91	3.29	5.61	0.02	.736
1.40	-18.66	32.92	3.10	5.32	0.02	.725
1.50	-17.23	29.61	2.92	5.07	0.03	.716
1.60	-15.79	26.76	2.76	4.84	0.03	.706
1.70	-14.56	24.32	2.63	4.63	0.03	.697
1.80	-13.35	22.27	2.51	4.43	0.03	.686
1.90	-12.48	20.33	2.39	4.26	0.04	.675
2.00	-11.24	18.73	2.30	4.07	0.04	.664
2.10	-10.37	17.44	2.23	3.92	0.04	.654
2.20	-9.49	16.40	2.17	3.77	0.05	.642

Pt

Energy (eV)	ε_1	ε_2	n	k	Im($-1/\tilde{\varepsilon}$)	R(ϕ=0)
2.30	-9.05	15.37	2.10	3.67	0.05	.636
2.40	-8.40	14.32	2.03	3.54	0.05	.626
2.50	-7.61	13.42	1.96	3.42	0.06	.616
2.60	-7.23	12.64	1.91	3.30	0.06	.605
2.70	-6.73	11.95	1.87	3.20	0.06	.595
2.80	-6.28	11.33	1.83	3.10	0.07	.585
2.90	-5.86	10.76	1.79	3.01	0.07	.575
3.00	-5.47	10.24	1.75	2.92	0.08	.565
3.10	-5.14	9.76	1.72	2.84	0.08	.556
3.20	-4.80	9.31	1.68	2.76	0.08	.546
3.30	-4.51	8.90	1.65	2.69	0.09	.537
3.40	-4.21	8.51	1.63	2.62	0.09	.527
3.50	-3.95	8.15	1.60	2.55	0.10	.518
3.60	-3.67	7.82	1.58	2.48	0.10	.507
3.70	-3.44	7.55	1.56	2.42	0.11	.498
3.80	-3.28	7.24	1.53	2.37	0.11	.491
3.90	-3.03	6.96	1.51	2.31	0.12	.480
4.00	-2.87	6.70	1.49	2.25	0.13	.472
4.20	-2.48	6.21	1.45	2.14	0.14	.452
4.40	-2.12	5.81	1.43	2.04	0.15	.432
4.60	-1.86	5.43	1.39	1.95	0.16	.415
4.80	-1.51	5.08	1.38	1.85	0.18	.392
5.00	-1.24	4.80	1.36	1.76	0.20	.372
5.20	-0.95	4.56	1.36	1.67	0.21	.350
5.40	-0.72	4.37	1.36	1.61	0.22	.332
5.60	-0.53	4.17	1.36	1.54	0.24	.315
5.70	-0.40	4.06	1.36	1.50	0.24	.304
5.80	-0.30	3.98	1.36	1.47	0.25	.295
5.90	-0.18	3.90	1.37	1.43	0.26	.285
6.00	-0.06	3.85	1.38	1.40	0.26	.276
6.10	0.04	3.80	1.38	1.37	0.26	.268
6.20	0.13	3.75	1.39	1.35	0.27	.261
6.30	0.25	3.69	1.40	1.32	0.27	.252
6.40	0.34	3.68	1.42	1.29	0.27	.246
6.50	0.43	3.67	1.43	1.28	0.27	.241
6.60	0.51	3.66	1.45	1.26	0.27	.236
6.70	0.59	3.67	1.47	1.25	0.27	.233
6.80	0.64	3.68	1.48	1.24	0.26	.231
6.90	0.68	3.70	1.49	1.24	0.26	.230
7.00	0.71	3.72	1.50	1.24	0.26	.230
7.20	0.69	3.73	1.50	1.25	0.26	.231
7.40	0.70	3.67	1.49	1.23	0.26	.228
7.60	0.71	3.62	1.48	1.22	0.27	.225
7.80	0.73	3.55	1.48	1.20	0.27	.221
8.00	0.77	3.48	1.47	1.18	0.27	.216
8.20	0.80	3.43	1.47	1.17	0.28	.212
8.40	0.83	3.39	1.47	1.15	0.28	.209
8.60	0.87	3.35	1.47	1.14	0.28	.205
8.80	0.90	3.32	1.47	1.13	0.28	.202
9.00	0.93	3.30	1.48	1.12	0.28	.200
9.20	0.98	3.30	1.49	1.11	0.28	.198
9.40	0.98	3.34	1.49	1.12	0.28	.200
9.60	0.94	3.37	1.49	1.13	0.28	.203
9.80	0.87	3.38	1.48	1.15	0.28	.207
10.00	0.79	3.36	1.46	1.15	0.28	.204
10.20	0.69	3.31	1.43	1.16	0.29	.211
10.40	0.62	3.22	1.40	1.15	0.30	.210

Pt

Energy (eV)	ε_1	ε_2	n	k	Im($-1/\tilde{\varepsilon}$)	R(ϕ=0)
10.60	0.58	3.12	1.37	1.14	0.31	.207
10.80	0.57	3.02	1.35	1.12	0.32	.203
11.00	0.56	2.93	1.33	1.10	0.33	.199
11.20	0.56	2.84	1.31	1.08	0.34	.194
11.40	0.58	2.75	1.30	1.06	0.35	.188
11.60	0.61	2.68	1.29	1.04	0.35	.183
11.80	0.64	2.62	1.29	1.01	0.36	.177
12.00	0.67	2.58	1.29	1.00	0.36	.173
12.20	0.70	2.53	1.29	0.98	0.37	.169
12.40	0.73	2.50	1.29	0.97	0.37	.165
12.60	0.75	2.47	1.29	0.96	0.37	.162
12.80	0.79	2.44	1.29	0.94	0.37	.158
13.00	0.82	2.43	1.30	0.93	0.37	.156
13.20	0.84	2.43	1.31	0.93	0.37	.155
13.40	0.86	2.43	1.31	0.93	0.37	.154
13.60	0.86	2.44	1.31	0.93	0.36	.155
13.80	0.85	2.43	1.31	0.93	0.37	.155
14.00	0.85	2.43	1.31	0.93	0.37	.155
14.20	0.83	2.43	1.30	0.93	0.37	.156
14.40	0.81	2.42	1.30	0.93	0.37	.156
14.60	0.78	2.41	1.29	0.94	0.38	.157
14.80	0.74	2.37	1.27	0.93	0.38	.157
15.00	0.79	2.31	1.27	0.91	0.39	.150
15.20	0.75	2.35	1.27	0.93	0.39	.155
15.40	0.73	2.30	1.25	0.92	0.39	.153
15.60	0.73	2.27	1.25	0.91	0.40	.151
15.80	0.74	2.23	1.24	0.90	0.40	.148
16.00	0.75	2.21	1.24	0.89	0.41	.146
16.25	0.76	2.19	1.24	0.88	0.41	.144
16.50	0.78	2.17	1.24	0.87	0.41	.142
16.75	0.80	2.15	1.24	0.87	0.41	.140
17.00	0.82	2.14	1.25	0.86	0.41	.138
17.25	0.85	2.14	1.26	0.85	0.40	.136
17.50	0.90	2.16	1.27	0.85	0.40	.135
17.75	0.93	2.21	1.29	0.86	0.38	.137
18.00	0.94	2.29	1.31	0.88	0.37	.142
18.25	0.89	2.38	1.31	0.91	0.37	.150
18.50	0.82	2.44	1.30	0.94	0.37	.157
18.75	0.75	2.48	1.29	0.96	0.37	.163
19.00	0.65	2.52	1.28	0.99	0.37	.171
19.25	0.56	2.53	1.25	1.01	0.38	.177
19.50	0.46	2.53	1.23	1.03	0.38	.184
19.75	0.37	2.52	1.21	1.04	0.39	.190
20.00	0.26	2.50	1.18	1.06	0.40	.197
20.25	0.17	2.46	1.15	1.07	0.40	.203
20.50	0.05	2.42	1.11	1.09	0.41	.212
20.75	-0.05	2.35	1.07	1.09	0.43	.219
21.00	-0.14	2.27	1.03	1.10	0.44	.226
21.25	-0.23	2.16	0.99	1.10	0.46	.234
21.50	-0.29	2.03	0.94	1.06	0.48	.238
21.75	-0.32	1.91	0.90	1.06	0.51	.240
22.00	-0.33	1.79	0.87	1.04	0.54	.240
22.25	-0.32	1.69	0.84	1.01	0.57	.238
22.50	-0.30	1.59	0.81	0.98	0.61	.235
22.75	-0.28	1.51	0.79	0.95	0.64	.231
23.00	-0.25	1.43	0.77	0.92	0.68	.225
23.25	-0.22	1.36	0.76	0.89	0.71	.220

Energy (eV)	ϵ_1	ϵ_2	n	k	Im(-1/$\tilde{\epsilon}$)	R(ϕ=0)
23.50	-0.19	1.31	0.75	0.87	0.75	.213
23.75	-0.16	1.26	0.75	0.84	0.78	.207
24.00	-0.13	1.21	0.74	0.82	0.82	.201
24.25	-0.10	1.17	0.73	0.80	0.85	.194
24.50	-0.07	1.13	0.73	0.77	0.88	.187
24.75	-0.04	1.10	0.73	0.75	0.91	.181
25.00	-0.01	1.07	0.73	0.73	0.93	.174
25.25	0.02	1.04	0.73	0.72	0.96	.168
25.50	0.04	1.02	0.73	0.70	0.98	.162
25.75	0.07	1.00	0.73	0.68	0.99	.155
26.00	0.09	0.99	0.74	0.67	1.00	.150
26.25	0.11	0.98	0.74	0.66	1.01	.145
26.50	0.13	0.96	0.74	0.65	1.02	.142
26.75	0.14	0.95	0.74	0.64	1.03	.139
27.00	0.15	0.94	0.74	0.63	1.04	.136
27.25	0.16	0.93	0.74	0.62	1.05	.133
27.50	0.17	0.91	0.74	0.62	1.06	.130
27.75	0.19	0.90	0.75	0.61	1.06	.127
28.00	0.19	0.90	0.75	0.60	1.07	.125
28.25	0.20	0.89	0.75	0.59	1.07	.123
28.50	0.21	0.88	0.75	0.59	1.08	.121
28.75	0.22	0.87	0.75	0.58	1.08	.119
29.00	0.22	0.87	0.75	0.58	1.08	.118
29.25	0.22	0.87	0.75	0.58	1.08	.119
29.50	0.21	0.87	0.74	0.58	1.09	.120
29.75	0.20	0.86	0.74	0.58	1.11	.122
30.00	0.19	0.84	0.73	0.58	1.13	.124

BIBLIOGRAPHY

AB71 A.V. Arutyunov, S.N. Banchila, and L.P. Filippov
Properties of titanium at temperatures above 1000°K
Teplo. Vys. Temp. 9, 535 (1971)

ABF72 A.V. Arutyunov, S.N. Banchila, and L.P. Filippov
Thermal, electrical, and emissive properties of hafnium in the high-temperature region
Teplofiz. Vys. Temp. 10, 425 (1972)

Aks74 L.N. Aksyutov
Normal spectral emissivity of gold, platinum, and tungsten
Inzh.-Fiz. Zh. 27, 197 (1974)

AU66 H.R. Aphölte and K. Ulmer
Temperaturabhängigkeit der Charakterische Energieverluste in Niob, Molybdan, Tantal und Wolfram
Phys. Lett. 22, 552 (1966)

Ba66 B.T. Barnes
Optical constants of incandescent refractory metals
J. Opt. Soc. Am. 56, 1546 (1966)

BaB74 D.N. Barla and R.G. Bautista
Effect of surface condition on the normal spectral emittance of titanium and zirconium between 1000 and 1800 K
Metallurgical Trans. 5, 555 (1974)

BB74 D.N. Barla and R.G. Bautista
Normal spectral emittance of vanadium and tantalum for different surface conditions at temperatures above 1000 K
Metallurgical Trans. 5, 1543 (1974)

BC67 G.A. Bolotin and T.P. Chukina
Optical properties of rhodium in the infrared spectral region
Opt. Spectrosc. 23, 333 (1967)
Opt. Spektrosk. 23, 620 (1967)

BD70 A.S. Barker, Jr. and J.A. Ditzenberger
Optical studies of antiferromagnetism in chromium and its alloys
Phys. Rev. B 1, 4378 (1970)

BDL77 R. Blickensderfer, D.K. Deardorff, and R.L. Lincoln
Normal total emittance at 400-850 K and normal spectral reflectance at room temperature of Be, Hf, Nb, Ta, Ti, V, and Zr
J. Less common Metals 51, 13 (1977)

BFF76 G. Blondeau, M. Froelicher, M. Froment, and A. Hugot-LeGoff
Simultaneous determination of the optical indices of an absorbant film and its metallic substrate by statistical analysis of spectroreflectance data: application to the oxide/titanium system
Thin Solid Films 38, 261 (1976)

BG68 M.A. Biondi and A.I. Guobadia
Infrared absorption of aluminum, copper, lead, and nickel at 4.2 K
Phys. Rev. 166, 667 (1968)

BGK71 F.C. Brown, G. Gähwiller, and A.B. Kunz
Extreme ultraviolet absorption and band density of NiO
Solid State Comm. 9, 487 (1971)

BHR68 A.S. Barker, Jr., B.I. Halperin, and T.M. Rice
Antiferromagnetic energy gap in chromium
Phys. Rev. Lett. 20, 384 (1968)

BKB73 D.N. Baria, T.S. King, and R.G. Bautista
The effect of surface finish on the normal spectral emittance of molybdenum between 1000 and 2400 K
High Temp.-High Pressures 5, 545 (1973)

BKM69 G.A. Bolotin, M.M. Kirillova, and V.M. Mayevskiy
Interband optical absorption in ferromagnetic iron
Phys. Met. Metall. 27, 31 (1969)
Fiz. Met. Metalloved. 27, 224 (1969)

BKN67 G.A. Bolotin, M.M. Kirillova, L.V. Nomerovannaya, and M.M. Noskov
Optical properties and Fermi surface of palladium
Phys. Met. Metall. 23, 72 (1967)
Fiz. Met. Metalloved. 23, 463 (1967)

BL70 L.W. Bos and D.W. Lynch
Optical properties of antiferromagnetic chromium and dilute Cr-Mn and Cr-Re alloys
Phys. Rev. B 2, 4567 (1970)

BLO77 E.S. Black, D.W. Lynch, and C.G. Olson
Optical properties (0.1-25 eV) of Nb-Mo and other Nb based alloys
Phys. Rev. B 16, 2337 (1977)

BLR76 Y. Ballu, J. Lecante, and H. Rousseau
Energy loss spectra of Mo(100) clean and covered with oxygen
Phys. Rev. B 14, 3201 (1976)

BS67 A.J. Blodgett, Jr. and W.E. Spicer
Experimental determination of the optical density of states in iron
Phys. Rev. 158, 514 (1967)

BSW78 R. Bruhn, B. Sonntag, and H.W. Wolff
3p-excitation of atomic Mn; Experimental evidence for the super Coster-Kronig decay
Phys. Lett. 69A, 9 (1978)

BVK62 G.A. Bolotin, A.N. Voloshinskii, M.M. Kirillova, M.M. Noskov, A.V. Sokolov, and B.A. Charikov
Optical properties of titanium and vanadium in the infra-red range of the spectrum
Phys. Met. Metall. 13, 24 (1962)
Fiz. Met. Metalloved. 13, 823 (1962)

CGS74 G. Chassaing, P. Gravier, M. Sigrist, and R. Pierrisnard
Etude de l'absorption optique du vanadium en couches minces
Interpretation par la théorie des bandes d'ènergie
Solid State Comm. 15, 1613 (1974)

CGS76 G. Chassaing, P. Gravier, and M. Sigrist
Electronic band structure and optical properties of vanadium, niobium and molybdenum thin films
Thin Solid Films 35, L25 (1976)

CHH71 J.T. Cox, G. Hass, and W.R. Hunter
Optical properties of evaporated niobium films deposited at various substrate temperatures in the vacuum ultraviolet from 150 to 2000 Å
J. Opt. Soc. Am. 61, 360 (1971)

CHR72 J.T. Cox, G. Hass, J.B. Ramsey, and W.R. Hunter
Reflectance of evaporated rhenium and tungsten films in the vacuum ultraviolet from 300 to 2000 Å
J. Opt. Soc. Am. 62, 781 (1972)

CHR73 J.T. Cox, G. Hass, J.B. Ramsey, and W.R. Hunter
Reflectance and optical constants of evaporated osmium in the vacuum ultraviolet from 300 to 2000 Å
J. Opt. Soc. Am. 63, 435 (1973)

CHR74 J.T. Cox, G. Hass, J.B. Ramsey, and W.R. Hunter
Reflectance and optical constants of evaporated ruthenium in the vacuum ultraviolet from 300 to 2000 Å
J. Opt. Soc. Am. 64, 423 (1974)

CM69 J.J. Carroll and A.J. Melmed
Ellipsometry-LEED study of the adsorption of oxygen on (011) tungsten
Surface Science 16, 251 (1969)

CM71 J.J. Carroll and A.J. Melmed
Optical constants of (011) tungsten in the visible region
J. Opt. Soc. Am. 61, 470 (1971)

CM74 J.J. Carroll and A.J. Melmed
Optical constants of titanium
J. Opt. Soc. Am. 64, 514 (1974)

CM76 J.J. Carroll and A.J. Melmed
Optical constants of (1120) ruthenium in the visible region
J. Opt. Soc. Am. 66, 1050 (1976)

CM77 A. Cezairliyan and A.P. Miller
Melting point, normal spectral emittance (at the melting point), and electrical resistivity (above 1900 K) of titanium by a pulse heating method
J. Research Natl. Bureau Standards 82, 119 (1977)

BIBLIOGRAPHY (cont'd)

CMB70 A. Cezairliyan, M.S. Morse, H.A. Berman, and C.W. Beckett
High-speed (subsecond) measurement of heat capacity, electrical resistivity, and thermal radiation properties of molybdenum in the range 1900-2800 K
J. Research Natl. Bureau Standards 74A, 65 (1970)

CoH73 J.K. Coulter, G. Hass, and J.B. Ramsey, Jr.
Optical constants and reflectance and transmittance of evaporated rhodium films in the visible
J. Opt. Soc. Am. 63, 1149 (1973)

CS79 G.E. Carver and B.O. Seraphin
Chemical-vapor-deposited molybdenum films of high infrared reflectance
Appl. Phys. Lett. 34, 279 (1979)

Da69 J. Daniels
Bestimmung von optischen Konstanten an Palladium und Silber aus Energieverlustmessungen im Energiebereich von 2 bis 90 eV
Z. Physik 227, 234 (1969)

Da Unpl J. Daniels
Ph.D. thesis, University of Hamburg
Unpublished

DFR70 J. Daniels, C.v. Festenberg, H. Raether, and K. Zeppenfeld
Optical constants of solids by electron spectrosocpy
Springer Tracts in Modern Physics, Vol. 54, ed. by G. Höhler (Springer-Verlag, Berlin, 1970) p. 77

DH64 L.F. Drummeter, Jr. and G. Hass
Solar absorptance and thermal emittance of evaporated coatings
Physics of Thin Films, Vol. 2, (Academic Press, Inc., New York, 1964) p. 305

DJ68 P.F. Dickson and M.C. Jones
Infrared spectral reflectances of metals at low temperatures
Cryogenics 8, 24 (1968)

DKM73 Zh. Duisebaeva, M.I. Korsunskii, and G.P. Motulevich
Optical properties of palladium
Opt. Spectrosc. 34, 307 (1973)
Opt. Spektrosk. 34, 535 (1973)

DKM74 Zh. Duisebaeva, M.I. Korsunskii, and G.P. Motulevich
Optical properties of palladium in the visible and near ir regions of the spectrum
Opt. Spectrosc. 37, 822 (1974)
Opt. Spektrosk. 37, 149 (1974)

DM65 B. Dold and R. Mecke
Optische Eigenschaften von Edelmatallen, Übergangsmetallen und deren Legierungen im Infrarot
Optik 22, 435 (1965)

BIBLIOGRAPHY (cont'd)

DMW80 R.E. Dietz, E.G. McRae, and J.H. Weaver
Core electron excitation edges in metallic Ni, Cu, Pt, and Au
Phys. Rev. B 21, 2229 (1980)

EPO63 H. Ehrenreich, H.R. Philipp, and D.J. Olechna
Optical properties and Fermi surface of nickel
Phys. Rev. 131, 2469 (1963)

FLS75 N. Fuschillo, B. Lalevic, W. Slusark, Jr., and A. Delahoy
Optical properties of thin Au-Cr films and their application to solar energy conversion
J. Vac. Sci. Technol. 12, 84 (1975)

FSH69 J. Feinleib, W.J. Scouler, and J. Hanus
Optical studies and band structure of Cu-Ni alloys
J. Appl. Phys. 40, 1400 (1969)

FSS79 L.A. Feldkamp, M.B. Stearns, and S.S. Shinozaki
Electronic structure and optical constants of Ni by electron inelastic scattering
Phys. Rev. B 20, 1310 (1979)

GCS79 P. Gravier, G. Chassaing, and M. Sigrist
Optical properties of thin films of bcc transition metals
Thin Solid Films 57, 93 (1979)

Gi Unpl F.E. Girouard
Unpublished

GL68 R.H.W. Graves and A.P. Lenham
Determination of the optical constants of uniaxial or isotropic metals by measurement of reflectance ratios
J. Opt. Soc. Am. 58, 884 (1968)

GLM69 A.I. Golovashkin, I.E. Leksina, G.P. Motulevich, and A.A. Shubin
The optical properties of niobium
Sov. Phys. JETP 29, 27 (1969)
Zh. Eksp. Teor. Fiz. 56, 51 (1969)

Gr72 P. Gravier
Optical properties of thin films of Mo
Thin Solid Films 11, 135 (1972)

GS77 H.S. Gurev and C. Selvage
Optical properties of thin film refractory metals
Proc. Soc. Photo-Optical Instr. Engineers 85, 32 (1977)

GSB78 V.S. Guschin, K.M. Shvarez, B.A. Baum, and P.V. Gel'd
Optical properties of nickel at high temperatures
Soviet Phys. Solid State 20, 948 (1978)
Fiz. Tverd. Tela. 20, 1637 (1978)

GSP68 P. Girault, A. Seignac, M. Priol, and S. Robin
Optical properties of chromium and lead in the far ultraviolet
C.R. Acad. Sc. Paris 266, 688 (1968)

BIBLIOGRAPHY (cont'd)

GSS73 N. Ya. Gorban, V.S. Stashchuk, A.V. Shirin, and A.A. Shishlovskii
Optical properties of nickel-iron alloys in the region of interband transitions
Opt. Spectrosc. 35, 295 (1973)
Opt. Spektrosk. 35, 508 (1973)

HAH79 W.R. Hunter, D.W. Angel, and G. Hass
Optical properties of evaporated platinum films in the vacuum ultraviolet from 220 Å to 150 Å
J. Opt. Soc. Am. 69, 1695 (1979)

HB57 G. Hass and A.P. Bradford
Optical properties and oxidation of evaporated titanium films
J. Opt. Soc. Am. 47, 125 (1957)

HH74 G. Hass and W.R. Hunter
Space Optics
National Academy of Sciences, Washington, D.C. (1974) p. 525

HJH67 G. Hass, G.F. Jacobus, and W.R. Hunter
Optical properties of evaporated iridium in the vacuum ultraviolet from 500 Å to 2000 Å
J. Opt. Soc. Am. 57, 758 (1967)

HL67 R.S. Hughes and A.W. Lawson
Search for an energy gap in chromium using infrared reflection and transmission
Phys. Lett. 25A, 473 (1967)

HR76 J.O. Hylton and R.L. Reid
System for the measurement of spectral emittance at high temperature
AIAA J. 14, 1303 (1976)

HRH69 G. Hass, J.B. Ramsey, and W.R. Hunter
Reflectance of the semitransparent platinum films on various substrates in the vacuum ultraviolet
Appl. Optics 8, 2255 (1969)

HRS69 R. Haensel, K. Radler, B. Sonntag, and C. Kunz
Optical absorption measurements of tantalum, tungsten, rhenium, and platinum in the extreme ultraviolet
Solid State Comm. 7, 1495 (1969)

HT59 G. Hass and R. Tousey
Reflecting coatings for the extreme ultraviolet
J. Opt. Soc. Am. 49, 593 (1959)

HTT77 B.U. Habedank, L.K. Thomas, and S. Thurm
Temperature dependence of optical properties of Ta-W-Re alloys
J. Phys. F: Metal Phys. 7, 2217 (1977)

BIBLIOGRAPHY (cont'd)

Hu71 W.R. Hunter
Comparison of the VUV reflectance spectra of evaporated films of some second and third series transition metals for wavelengths less than 2000 Å
Proc. III Int. Conf. Vac. Ultraviolet Rad. Physics, Tokyo (1971)

JC74 P.B. Johnson and R.W. Christy
Optical constants of transition metals: Ti, V, Cr, Mn, Fe, Co, Ni, and Pd
Phys. Rev. B 9, 5056 (1974)

JCF68 P. Jaegle, F. Combet Farnoux, P. Dhez. M. Cremonese, and G. Onori
Experimental and theoretical study of the absorption of ultrasoft x-rays in platinum and tantalum
Phys. Lett. 26A, 364 (1968)

JLM68 D.W. Juenker, L.J. LeBlanc, and C.R. Martin
Optical properties of some transition metals
J. Opt. Soc. Am. 58, 164 (1968)

JMC63 G.F. Jacobus, R.P. Madden, and L.R. Canfield
Reflecting films of platinum for the vacuum ultraviolet
J. Opt. Soc. Am. 53, 1084 (1963)

JPT72 J.C. Jones, D.C. Palmer, and C.L. Tien
Infrared absorptivities of transition metals at room and liquid-helium temperatures
J. Opt. Soc. Am. 62, 353 (1972)

KBM67 M.M. Kirillova, G.A. Bolotin, and V.M. Mayevskiy
Interband transitions in molybdenum
Phys. Met. Metall. 24, 91 (1967)
Fiz. Met. Metalloved. 24, 95 (1967)

KC63 M.M. Kirillova and B.A. Charikov
Study of the optical properties of transition metals
Opt. Spectrosc. 17, 134 (1963)
Opt. Spektrosk. 17, 254 (1963)

KC65 M.M. Kirillova and B.A. Charikov
Quantum light absorption by certain transition metals
Phys. Met. Metall. 19, 13 (1965)
Fiz. Met. Metalloved. 19, 495 (1965)

KCh63 M.M. Kirillova and B.A. Charikov
Optical properties of titanium in the quantum transition range
Phys. Met. Metall. 15, 138 (1963)
Fiz. Met. Metalloved. 15, 315 (1963)

Ki72 M.M. Kirillova
Electron interband transitions in nickel
Sov. Phys. JETP 34, 178 (1972)
Zh. Eksp. Teor. Fiz. 61, 336 (1971)

KIN75 M.M. Kirillova and L.V. Nomerovannaya
Features of infrared absorption in chromium and its alloys with iron
Phys. Met. Metall. 40, 69 (1975)
Fiz. Met. Metalloved. 40, 983 (1975)

KL70 K.A. Kress and G.J. Lapeyre
Optical properties of molybdenum and ruthenium
J. Opt. Soc. Am. 60, 1681 (1970)

KN68 M.M. Kirillova and M.M. Noskov
Optical properties of chromium
Phys. Met. Metall. 26, 189 (1968)
Fiz. Met. Metalloved. 26, 952 (1968)

KN75 M.M. Kirillova and L.V. Nomerovannaya
Optical absorption in the system of chromium-vanadium alloys
Opt. Spectrosc. 39, 303 (1975)
Opt. Spektrosk. 39, 540 (1975)

KN78 M.M. Kirillova and L.V. Nomerovannaya
Optical properties of d transition metals with bcc lattices
Sov. Phys. Solid State 20, 568 (1978)
Fiz. Tverd. Tela. 20, 984 (1978)

KNB68 M.M. Kirillova, L.V. Nomerovannaya, G.A. Bolotin, V.M. Mayevskiy, M.M. Noskov, and M.L. Bolotina
Optical properties of transition metals in the vacuum ultraviolet band
Phys. Met. Metall. 25, 81 (1968)
Fiz. Met. Metalloved. 25, 459 (1968)

KNN71 M.M. Kirillova, L.V. Nomerovannaya, and M.M. Noskov
Optical properties of molybdenum single crystals
Sov. Phys. JETP 33, 1210 (1971)
Zh. Eksp. Teor. Fiz. 60, 2252 (1971)

KNN72 M.M. Kirillova, L.V. Nomerovannaya, and M.M. Noskov
Optical properties of iridium at 77 and 295°K
Phys. Met. Metall. 34, 61 (1972)
Fiz. Met. Metalloved. 34, 291 (1972)

KNN75 M.M. Kirillova, L.V. Nomerovannaya, and M.M. Noskov
Interband optical absorption and the electronic structure of 5d metals
Sov. Phys. Solid State 16, 1425 (1975)
Fiz. Tverd. Tela. 16, 2181 (1974)

KNN78 M.M. Kirillova, L.V. Nomerovannaya, M.M. Noskov, N.B. Gorina, V.P. Polyakova, and E.M. Savitskii
Optical properties of a ruthenium single crystal
Sov. Phys. Solid State 20, 994 (1978)
Fiz. Tverd. Tela. 20, 1718 (1978)

Kon69 B.A. Konyaev
Determination of the emittance from the surface of tungsten
Teplo. Vys. Temp. 7, 1029 (1969)

KrL70 K.A. Kress and G.J. Lapeyre
Photoemission and optical investigation of the electronic structure of ruthenium
Phys. Rev. B 2, 2532 (1970)

KUS69 M.L. Kapitsa, Yu. P. Udoev, and E.I. Shirokikh
Optical properties of molybdenum in the range of 2-10 eV
Sov. Phys. Sol. State 11, 665 (1969)
Fiz. Tverd. Tela. 11, 814 (1969)

LAT78 J. Lafait, F. Abelès, M.L. Theye, and G. Vuye
Determination of the infrared optical constants of highly reflecting materials by means of surface plasmon excitation-application to Pd
J. Phys. F: Metal Phys. 8, 1597 (1978)

LA Unpl E. Lluesma and D.E. Aspnes
Unpublished

LCS70 L.N. Latyev, V. Ya. Cheknovskoi, and E.N. Shestakov
Monochromatic emissivity of tungsten in the temperature range 1200-2600°K and in the wavelength range 0.4-4 μm
High Temp.-High Pressures 2, 175 (1970)

LCS72 L.N. Latyev, V. Ya. Chechovskoi, and E.N. Shestakov
Tungsten as a standard material for monochromatic emissivity
High Temp.-High Pressures 4, 679 (1972)

Le67 A.P. Lenham
Absorption of low-energy photons in the transition metals
J. Opt. Soc. Am. 57, 473 (1967)

LFJ64 L.J. LeBlanc, J.S. Farrell, and D.W. Juenker
Far-ultraviolet reflectance of several transition metals
J. Opt. Soc. Am. 54, 956 (1964)

Li72 R.C. Linton
The optical properties of platinum and gold in the vacuum ultraviolet
NASA Technical Note D-7061, October 1972

Lo64 P. Lostis
Détermination et étude des properiétés optiques des couches minces de palladium
J. de Physique 25, 118 (1964)

Log72 A.V. Logunov
Thermophysical properties of single-crystalline rhenium in the high-temperature region
Teplo. Vys. Temp. 10, 988 (1972)

LOW75 D.W. Lynch, C.G. Olson, and J.H. Weaver
Optical properties of Ti, Zr, and Hf from 0.15 to 30 eV
Phys. Rev. B 11, 3617 (1975)

LP62 I.Y. Leksina and N.V. Penkina
Optical properties of dilute solid solutions of rhodium-platinum
Phys. Met. Metall. 13, 165 (1962)
Fiz. Met. Metalloved. 13, 799 (1962)

LP66 I.Y. Leksina and N.V. Penkina
Optical properties of dilute tungsten-rhenium solid solutions
Phys. Met. Metall. 22, 104 (1966)
Fiz. Met. Metalloved. 22, 264 (1966)

LRW71 D.W. Lynch, R. Rosei, and J.H. Weaver
Infrared and visible optical properties of single-crystal Ni at 4 K
Solid State Comm. 9, 2195 (1971)

LS72 M.A. Lind and J.L. Stanford
Optical measurements of the antiferromagnetic energy gaps in chromium
Phys. Lett. 39A, 5 (1972)

LSE64 A.P. Lukirskii, E.P. Savinov, O.A. Ershov, and Yu. F. Shepelev
Reflection coefficients of radiation in the wavelength range from 23.6 to 113 Å for a number of elements and substances and the determination of the refractive index and absorption coefficient
Opt. Spectrosc. 16, 168 (1964)
Opt. Spektrosk. 16, 310 (1964)

LT66 A.P. Lenham and D.M. Treherne
Optical constants of transition metals in the infrared
J. Opt. Soc. Am. 56, 1137 (1966)

LT75 L.J. LeBlanc and V.V. Truong
Les propriétés optiques du hafnium dans l'ultraviolet à vide
Canadian J. Phys. 53, 1025 (1975)

LTA66 A.P. Lenham and D.M. Treherne
Optical Properties and Electronic Structure of Metals and Alloys
ed. by F. Abelès, (North-Holland Publishing Co., Amsterdam, 1966)
p. 196

LO Unpl D.W. Lynch and C.G. Olson
Unpublished

Man80 R. Manzke
Optical properties of molybdenum by electron energy loss spectroscopy
Phys. Stat. Sol. B 97, 157 (1980)

MC61 R.P. Madden and L.R. Canfield
Apparatus for the measurement of vacuum ultraviolet optical properties of freshly evaporated films before exposure to air
J. Opt. Soc. Am. 51, 838 (1961)

MKN76 A. Moritani, K. Kondo, and J. Nakai
Reflectance and wavelength-modulated reflectance measurements by a double beam-single detector system
Japan J. Appl. Phys. 15, 1549 (1976)

MM72 I.D. Mash and G.P. Motulevich
Optical constants and electronic characteristics of titanium
Sov. Phys. JETP 36, 516 (1973)
Zh. Eksp. Teor. Fiz. 63, 985 (1972)

MRD76 T.J. Moravec, J.C. Rife, and R.N. Dexter
Optical constants of nickel, iron, and nickel-iron alloys in the vacuum ultraviolet
Phys. Rev. B 13, 3297 (1976)

MS69 C.E. McCain and K. Schröder
Optical properties of chromium rich chromium iron alloys at room temperature
J. Phys. Chem. Solids 31, 878 (1969)

MSM74 A.H. Madjid, R.L. Stover, and J.M. Martinez
Normal spectral emissivity of platinum in the red and in the green in vacuum and helium
Phys. Kond. Matter 17, 125 (1974)

MT57 D. Malé and J. Trompette
Properiétés optiques du palladium en couches minces
J. de Physique et le Radium 18, 128 (1957)

NC80 J.E. Nestell, Jr. and R.W. Christy
Optical conductivity of bcc transition metals: V, Nb, Ta, Cr, Mo, W
Phys. Rev. B 21, 3173 (1980)

NCC80 J.E. Nestell, R.W. Christy, M. Cohen, and G.C. Ruben
Structure and optical properties of evaporated films of the Cr- and V-group
J. Appl. Phys. 51, 655 (1980)

NKN71 L.V. Nomerovannaya, M.M. Kirillova, and M.M. Noskov
Optical properties of tungsten monocrystals
Sov. Phys. JETP 33, 405 (1971)
Zh. Eksp. Teor. Fiz. 60, 748 (1971)

NKN72 L.V. Nomerovannaya, M.M. Kirillova, and M.M. Noskov
Optical absorption in tungsten at T = 77°K
Sov. Phys. Solid State 14, 541 (1972)
Fiz. Tverd. Tela. 14, 633 (1972)

NKN73 L.V Nomerovannaya, M.M. Kirillova, M.M. Noskov, and G.A. Bolotin
Optical and electrical properties of rhenium
Phys. Met. Metall. 36, 66 (1973)
Fiz. Met. Metalloved. 36, 1197 (1973)

BIBLIOGRAPHY (cont'd)

NS66 M.M. Noskov and I.I. Sasovskaya
Characteristics of infrared absorption in copper-nickel alloys
Opt. Spectrosc. 22, 358 (1966)
Opt. Spektrosk. 22, 657 (1966)

OL Unpl C.G. Olson and D.W. Lynch
Unpublished

PD71 V.E. Peletskii and V.P. Druzhinin
Experimental study of some physical properties of hafnium at high temperatures
Teplo. Vys. Temp. 9, 539 (1971)

PDS70 V.E. Peletskii, V.P. Druzhinin, and Y.G. Sobol
Emissivity, thermal conductivity, and electrical conductivity of remelted zirconium at high temperatures
Teplo. Vys. Temp. 8, 774 (1970)

PS73 D.T. Pierce and W.E. Spicer
Optical properties of rhodium
Phys. Stat. Sol. B 60, 689 (1973)

RCF80 R. Rosei, E. Colavita, A. Franciosi, J.H. Weaver, and D.T. Peterson
Electronic structure of the bcc transition metals: Thermoreflectance studies of bulk V, Nb, Ta, and α-TaH$_x$
Phys. Rev. B 21, 3152 (1980)

RG75 B.K. Reddy and T.C. Goel
Total and spectral emittances and electrical resistivity of nickel at high temperatures
Indian J. Appl. Phys. 13, 138 (1975)

Ri68 M.S. Riedinger
Determination of optical constants of palladium by ellipsometry
M.S. Thesis, Vanderbilt University
Unpublished (1968)

Ro66 S. Robin
Propriétés optiques de l'argent et du palladium dans l'ultraviolet lointain
Optical Properties and Electronic Structure of Metals and Alloys
ed. by F. Abelès (North Holland Publishing Co., Amsterdam, 1966)
p. 202

Ro70 J. Römer
Experimentalle Bestimmung der optischen Konstanten aus Reflexionsmessungen im Gebiet des weichen Röntgenlichts
Thesis, Hamburg University, 1970

Rob59 S. Roberts
Optical properties of nickel and tungsten and their interpretation according to Drude's formula
Phys. Rev. 114, 104 (1959)

BIBLIOGRAPHY (cont'd)

Rod72 J.J. Rodgers
Measurements of the spectral emissivity of tungsten using Fourier transform spectroscopy
High Temp.-High Pressures 4, 271 (1972)

Sa39 G.B. Sabine
Reflectivities of evaporated metal films in the near and far ultraviolet
Phys. Rev. 55, 1064 (1939)

SCG75 M. Sigrist, G. Chassaing, and P. Gravier
Optical absorption of thin films of Nb between 0.32 and 5.5 eV
Solid State Comm. 17, 647 (1975)

SCGP75 M. Sigrist, G. Chassaing, P. Gravier, and R. Pierrisnard
Optical transmission of thin films of Nb (0.32-5.5 eV)
C.R. Acad. Sc. Paris 280, 413 (1975)

SHK69 B. Sonntag, R. Haensel, and C. Kunz
Optical absorption measurements of the transition metals Ti, V, Cr, Mn, Fe, Co, Ni in the region of 3p electron transitions
Solid State Comm. 7, 597 (1969)

SJ78 M. Ph. Stoll and C. Jung
Nouvelles données expérimentales sur l'absorption optique de nickel entre 2 et 3 eV
J. Physique 39, 389 (1978)

SJ79 M. Ph. Stoll and C. Jung
Optical constants of nickel: (I) influence of temperature, (II) relation to bandstructure
J. Phys. F: Metal Phys. 9, 2491 (1979)

Sm72 T. Smith
Optical constants of clean titanium and tungsten surfaces as functions of temperature
J. Opt. Soc. Am. 62, 774 (1972)

Sm77 T. Smith
Optical constants of copper and nickel
J. Opt. Soc. Am. 67, 48 (1977)

SN71 I.I. Sasovskaya and M.M. Noskov
Optical properties of nickel
Phys. Met. Metall. 32, 48 (1971)
Fiz. Met. Metalloved. 32, 723 (1971)

SN75 I.I. Sasovskaya and M.M. Noskov
Optical properties of Ni-Cu alloys
Opt. Spectrosc. 39, 64 (1975)
Opt. Spektrosk. 39, 111 (1975)

SP69 M. Shiga and G.P. Pells
The optical properties of nickel above and below the Curie temperature
J. Phys. C: Solid State Phys. 2, 1847 (1969)

SPS67 J.A.R. Samson, J.P. Padur, and A. Sharma
Reflectance and relative transmittance of laser-deposited iridium in the vacuum ultraviolet
J. Opt. Soc. Am. 57, 966 (1967)

SR70 A. Seignac and S. Robin
Propriétés optiques de couches minces de rhodium et de vanadium dans l'ultraviolet lointain
C.R. Acad. Sc. Paris B 271, 919 (1970)

SR72 A. Seignac and S. Robin
Propriétés optiques de couches minces de platine dans l'ultraviolet lointain
Solid State Comm. 11, 217 (1972)

SS70 D.H. Seib and W.E. Spicer
Photoemission and optical studies of Cu-Ni alloys. II. Ni-rich and nearly equiatomic alloys
Phys. Rev. B 2, 1694 (1970)

SS72 G.W. Simmons and E.J. Scheibner
Characteristic energy-loss spectra of titanium, vanadium, and chromium
J. Appl. Phys. 43, 693 (1972)

St70 M. Ph. Stoll
Optical properties of nickel in the visible and near infra-red
Solid State Comm. 8, 1207 (1970)

St71 M. Ph. Stoll
Optical spectrum and spin-orbit splitting of nickel
J. Appl. Phys. 42, 1717 (1971)

St74 M.R. Steel
Comparison of the optical properties of V, Cr, and Mn with nondirect transitions calculations
J. Phys. F: Metal Phys. 4, 783 (1974)

St75 A.A. Studna
High-resolution ellipsometric measurements of Ni from 1.8 to 3.5 eV
Solid State Comm. 16, 1063 (1975)

ST77 A.S. Siddiqui and D.M. Treherne
Optical properties of some transition metals at infrared frequencies
Infrared Phys. 17, 33 (1977)

TDB77 M. Tokumoto, H.D. Drew, and A. Bagchi
Optical absorption of NiCu alloys
Phys. Rev. B 16, 3497 (1977)

Th68 L.K. Thomas
The normal spectral emissivity of tungsten-molybdenum alloys
Phys. Stat. Sol. 28, 401 (1968)

TLT78 V.V. Truong, L.J. LeBlanc, and G.J. Turpin
Optical properties of bulk niobium from 6.6 to 23 eV
J. Opt. Soc. Am. 68, 1017 (1978)

TSV65 C. Tingvoldt, U. Schley, J. Verch, and S. Takata
Di optischen Konstanten von Wolfram und Hafnium bei Glühtemperaturen
Optik 22, 48 (1965)

TT76 L.K. Thomas and S. Thurm
Optical properties of Ta-W-Re alloys from 0.5 to 5 eV
J. Phys. F: Metal Phys. 6, 279 (1976)

Ud72 Y.P. Udoev
Optical spectra of metals of the chromium subgroup
Opt. Spectrosc. 33, 185 (1972)
Opt. Spektrosk. 33, 350 (1972)

UKK71 Y.P. Udoeyev, N.S. Koz'yakova, and M.L. Kapitsa
Optical properties of tungsten and molybdenum
Phys. Met. Metall. 31, 229 (1971)
Fiz. Met. Metalloved. 31, 439 (1971)

VA69 R.C. Vehse and E.T. Arakawa
Optical and photoemissive properties of nickel in the vacuum ultraviolet spectral region
Phys. Rev. 180, 695 (1969)

VAK67 F.I. Vilesov, A.A. Azgrubskii, and M.M. Kirillova
The photoemission method for obtaining mirror and diffuse reflection spectra in the vacuum ultraviolet region of the spectrum
Opt. Spectrosc. 23, 79 (1967)
Opt. Spektrosk. 23, 153 (1967)

VAW70 R.C. Vehse, E.T. Arakawa, and M.W. Williams
Optical and photoemissive properties of palladium in the vacuum ultraviolet spectral region
Phys. Rev. B 1, 517 (1970)

VP73 B.W. Veal and A.P. Paulikas
Precision reflectance measurements between 2 and 3 eV in nickel
Int. J. Magnetism 4, 57 (1973)

BIBLIOGRAPHY (cont'd)

VP74 B.W. Veal and A.P. Paulikas
Optical properties of molybdenum
Phys. Rev. B 10, 1280 (1974)

Vuj70 V. Vujnovic
Tungsten emissive properties
J. Opt. Soc. Am. 60, 177 (1970)

Vuj72 V. Vujnovic and B. Grzeta
Analysis of the emissive properties of molybdenum from 1000-2000°K
Fizika 4, 173 (1972)

WB75 J.H. Weaver and R.L. Benbow
Low energy interband absorption in Pd
Phys. Rev. 12, 3509 (1975)

WCL79 J.H. Weaver, E. Colavita, D.W. Lynch, and R. Rosei
Low energy interband structures in bcc Fe and hcp Co
Phys. Rev. B 19, 3850 (1979)

We75 J.H. Weaver
Optical properties of Rh, Pd, Ir, and Pt
Phys. Rev. B 11, 1416 (1975)

WeG74 C. Wehenkel and B. Gauthé
Optical absorption coefficient of the first series transition metals between 20 and 130 eV
Phys. Lett. 47A, 253 (1974)

WeO75 J.H. Weaver, C.G. Olson, D.W. Lynch, and M. Plancentini
Thermoreflectance of Mo from 0.5 to 35 eV
Solid State Comm. 16, 163 (1975)

WG74 C. Wehenkel and B. Gauthé
Optical absorption coefficient of nickel, palladium, platinum, copper, silver, gold between 20 and 120 eV
Optics. Comm. 11, 62 (1974)

WGa74 C. Wehenkel and B. Gauthé
Electron energy loss spectra and optical constants for the first transition series from 2 to 120 eV
Phys. Stat. Sol. B 64, 515 (1974)

Wie75 U. Wiesner
Bestimmung des Emissionskoeffizienten non Reinsteisen
Exp. Technik. Physik 23, 363 (1975)

WJ64 J.P. Waldron and D.W. Juenker
Optical properties of clean molybdenum
J. Opt. Soc. Am. 54, 204 (1964)

BIBLIOGRAPHY (cont'd)

WLO73 J.H. Weaver, D.W. Lynch, and C.G. Olson
Optical properties of Nb from 0.1 to 36.4 eV
Phys. Rev. B 7, 4311 (1973)

WLO74 J.H. Weaver, D.W. Lynch, and C.G. Olson
Optical properties of V, Ta, and Mo from 0.1 to 30 eV
Phys. Rev. B 10, 501 (1974)

WOL75 J.H. Weaver, C.G. Olson, and D.W. Lynch
Optical properties of crystalline W from 0.1 to 32 eV
Phys. Rev. B 12, 1293 (1975)

WO76 J.H. Weaver and C.G. Olson
Optical absorption in the 4d transition metals from 20 to 250 eV
Phys. Rev. B 14, 3251 (1976)

WOL77 J.H. Weaver, C.G. Olson, and D.W. Lynch
Optical investigation of the electronic structure of bulk Rh and Ir
Phys. Rev. B 15, 4115 (1977)

WOL Unpl J.H. Weaver, C.G. Olson, and D.W. Lynch
Unpublished

WRS80 W. Wall, M.W. Ribarsky, and J.R. Stevenson
Optical reflectivity and Auger spectroscopy of Ti and Ti-Al alloys
J. Appl. Phys. 51, 661 (1980)

WSG80 L.A. Wojcik, A.J. Sievers, G.W. Graham, and T.N. Rhodin
Total hemisphere emissivity Of W(100)
J. Opt. Soc. Am. 70, 443 (1980)

YDS68 A. Y-C. Yu, T.M. Donovan, and W.E. Spicer
Optical properties of cobalt
Phys. Rev. 167, 670 (1968)

YK65 H.T. Yolken and J. Kruger
Optical constants of iron in the visible region
J. Opt. Soc. Am. 55, 842 (1965)

YS68 A. Y-C. Yu and W.E. Spicer
Photoemission and optical studies of the electronic structure of Pd
Phys. Rev. 169, 497 (1968)

YSH68 A.Y-C. Yu. W.E. Spicer, and G. Hass
Optical properties of platinum
Phys. Rev. 171, 834 (1968)

Zho74 G.A. Zhorov
Electrical resistivity and emissivity of some transition metals and alloys in the high-temperature range
Teplo. Vys. Temp. 10, 1332 (1974)

BIBLIOGRAPHY (cont'd)

ZR71 G.L. Zuppardo and K.G. Ramanathan
Anomalous emissivities of nickel and iron near their Curie temperatures
J. Opt. Soc. Am. <u>61</u>, 1607 (1971)