Phys. Educ. **55** (2020) 023005 (2pp) iopscience.org/ped

Mosquito racket and capacitor

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Abstract
A simple lab with a parallel-plate capacitor.

First capacitors were built in the shape of a jar because water stored inside served as one of the plates [1]. Although we know for over a century that a parallel-plate capacitor is as good as a Leyden jar, the tradition is very strong. In many educational publications, both in paper and online, when it comes to simple experiments, jar-like capacitors are described rather than parallel-plates ones.

However, building the latter is very easy. The plates can be made of kitchen aluminium foil, and the dielectric of PVC sheet protectors (one or more depending on the voltage).

How do we charge such a capacitor? The cheapest device is a mosquito racket, already described in [2] as a school laboratory equipment. The voltage of the racket I have used is 730 V. It is enough for a visible and audible spark while discharging the capacitor.

If we use a more sophisticated high voltage source such as a van de Graaff generator, or a racket producing higher voltage, several sheet protectors placed together are needed to avoid electric breakdown. However, observing the breakdown is interesting in itself. Volcano-shaped traces of sparks are spotted all over aluminium foil while the PVC stays intact.

The experiment is purely qualitative and hard to upgrade to a quantitative measurement. Although it is easy to measure the potential difference (at least during charging), measuring the electric charge is hardly possible in a typical school laboratory. Even the distance between the plates can be only estimated.

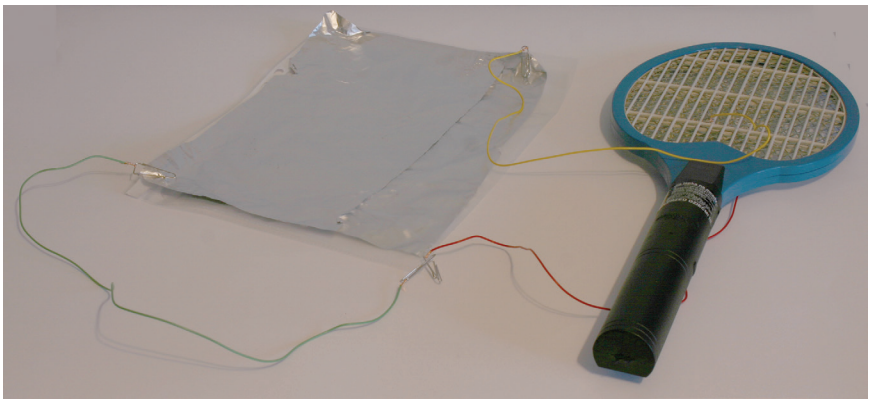
However, as far as a demonstration of how a capacitor works is concerned, the experiment described above is useful for students. In my opinion it is better than using an electrolytic capacitor. The latter allows us to light a LED for seconds, but is a 'black box' for the students.

In addition to its low cost and simplicity, our experiment makes visible a phenomenon that in most cases is only described: attraction between the plates. When the racket or generator is being turned on, both pieces of foil move closer to the dielectric.

Moreover, it brings to an end the discrepancy between the use of jars in labs and parallel-plate capacitors in quantitative descriptions.

Last but not least, we can observe the long-lasting polarization of PVC [3]. Even some days after charging the capacitor for the first time, aluminium foil sticks to the dielectric.

1361-6552/20/023005+2$33.00



Received 25 November 2019, in final form 12 December 2019
Accepted for publication 20 December 2019
https://doi.org/10.1088/1361-6552/ab64b4

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