Electrons give resist layer electrical charge

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Credit: Leiden University

Leiden physicists found a surprising interaction between electrons and a resist layer. The resist appears to charge and discharge due to incoming electrons. Publication in *Physical Review Letters*.

The delicate patterns on chips for computers and smartphones are 'written' with light. To make chips more powerful, manufacturers need to write even smaller patterns. For that they require light with shorter wavelength. For decades, the semiconductor industry has been investing in the development of a technology based on Extreme Ultraviolet (EUV) light, with a wavelength of 13.5 nanometer—six thousand times smaller than the thickness of a human hair.

EUV light does not write patterns directly on a chip, but first creates a burst of electrons. This electron shower then writes the pattern on the chip. Nobody knows exactly how the electrons do this. A team of physicists at Leiden University, ARCNL and IBM researches this writing process by skipping the EUV light and firing electrons directly at a resist layer. They do not use an entire burst with a jumble of different energies, but instead use electrons of a predetermined energy. This enables them to increase the energy step-by-step, so they can monitor closely how the resist reacts with each step.

The researchers found a surprising effect. Their resist got electrically charged, while previously it was assumed that the exposure process is electrically neutral. Sometimes the charge even jumps abruptly from negative to positive. The researchers explain these unexpected results with a model containing a piece of catastrophe theory. This branch of mathematics explains for example why a scared dog suddenly switches from submissive to aggressive behavior.

More information: A. Thete et al. Charge Catastrophe and Dielectric Breakdown During Exposure of Organic Thin Films to Low-Energy Electron Radiation, *Physical Review Letters* (2018). DOI: 10.1103/PhysRevLett.119.266803

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