New transmission microscope for low-energy electrons

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Physicist Daniël Geelen (Leiden University) has developed a new microscope that uses low-energy electrons. Those are less harmful to biological and organic materials. Geelen defended his Ph.D. thesis on May 31st.

Electron microscopes offer scientists insight into a world which is inaccessible to 'normal' microscopes based on light. Electrons expose more detail than light particles because of their smaller wavelength. A transmission electron microscope (TEM) detects electrons that fly through a material. Using this technique, scientists saw for example a virus for the first time. TEM formed even the basis for two Nobel Prizes, in 1986 and 2017. Ph.D. student Daniël Geelen has now developed a new type.

The traditional type of TEM uses electrons with high energy, which easily fly through a sample and therefore produce high-contrast images. But such electrons also do a lot of damage, which poses a problem when studying delicate biomaterials. In theory, less harmful low-energy electrons would also fly through a sample, because they can transfer only little energy to the material. Daniël Geelen studied this option during his Ph.D. with Sense Jan van der Molen and Ruud Tromp. He developed the idea into a prototype electronVolt Transmission Electron Microscope (eV-TEM).

In addition to biological materials such as DNA, you can also use eV-TEM to study flat materials of one atom thick—for example layers of

graphene or gold. The new microscope not only provides accurate images, but in combination with a reflective electron microscope it also reveals electronic properties. With his dissertation, Geelen has started the development of a new branch in electron microscopy.

Provided by Leiden University