Exciting plasmons: Researchers tackle the tiniest technology to make gadgets smaller, faster, more efficient

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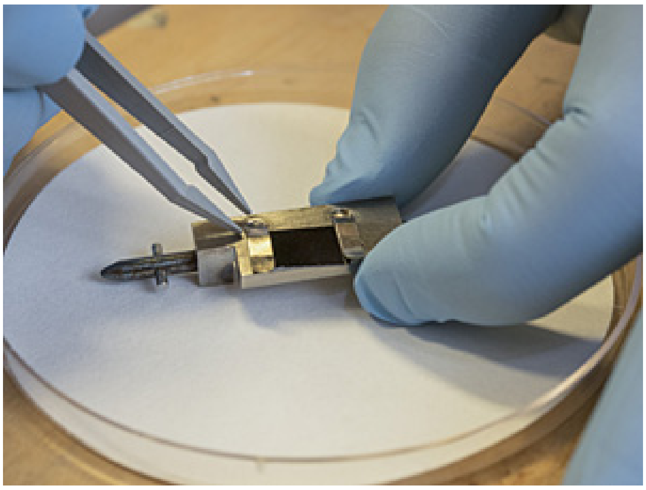


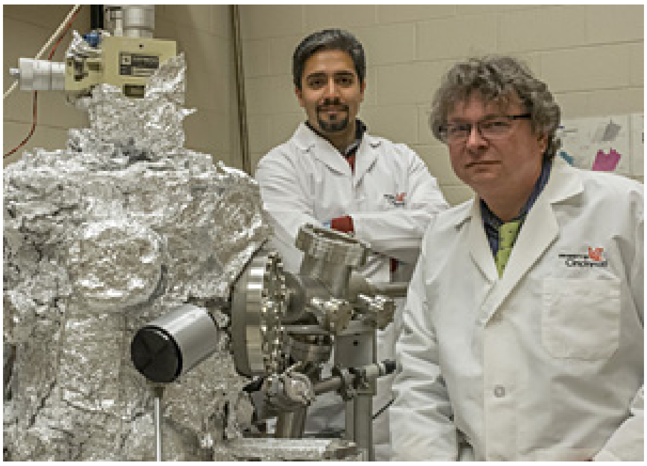
(Phys.org) —University of Cincinnati researchers are discovering how to manipulate light to one day better view the world's tiniest objects through a super-lens, as well as how to hide an object in plain sight.

Masoud Kaveh-Baghbadorani, a doctoral student in the University of Cincinnati's physics program, will present this research on March 4, at the American Physical Society Meeting in Denver.

The research focuses on exciting collective oscillations of metal electrons called plasmons, and on directing light through nanometer-thin metal films, about a thousand times thinner than a human hair. The result could empower integrated circuits or facilitate a super-lens with seven times the strength of a standard microscope, opening further research into fields such as studying microorganisms and viruses.

Other applications involve bouncing light around an object by cloaking it with a metamaterial film. Instead of the object reflecting light and thus causing it to be seen, the light manipulation can make it invisible.

Plasmonics is an emerging field, but it has its limitations due to the loss of energy in the metal layers, which dissipate the plasmon energy into heat. Kaveh-Baghbadorani's research focuses on developing hybrid metal/organic nanowires that essentially work as an energy pump to compensate for metal losses in plasmonic nanostructures.



Masoud Kaveh-Baghbadorani, left, and Hans-Peter Wagner

This energy pump results from exciton radiation, an electronic excitement in the semiconductor nanowires. Kaveh-Baghbadorani explains that the exciton functions somewhat like a hydrogen atom – negative and positive charges are bound together. The research is examining energy transfer from excitons in semiconductor nanowires to different metal materials used to cover the nanowires, as well as the effects of the thickness of covering organic layers in energy transfer.

The researchers want to know how the dynamics of excitons are affected by the use of different organic materials, and how lifetime and energy transferring processes of nanowire excitons are modified by changing the design of the nanowires or the thickness of organic spacer layers.

Kaveh-Baghbadorani's advisor, Hans-Peter Wagner, a UC associate professor of physics, is one of the co-researchers on the project. "To achieve our goal, the knowledge of exciton relaxation and energy-transfer processes in plasmonic semiconductor nanowire heterostructures is of crucial importance," says Wagner, whose lab has a growth facility to allow researchers to produce a variety of plasmonic structures. The lab also has special optical methods to measure exciton relaxation processes on a sub-picosecond time-scale.

Co-researchers on the project include Wagner; Qiang Gao, research fellow, and Chennupati Jagadish, professor of engineering, Australian National University, where the semiconductor nanowires are produced; and Gerd Duscher, professor of engineering, University of Tennessee.

Provided by University of Cincinnati