Gold nanoparticles improve photodetector performance

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The mineral molybdenum disulfide (MoS2), which, when solid, behaves in many ways like grease, has semiconducting properties that make it a promising alternative to silicon or graphene in electronic devices. It also strongly absorbs visible light, and so it has been widely employed in light-sensing photodetectors, which are used in a wide range of technologies, such as environmental sensing, process control in factories, and optical communication devices.

Researchers at the National University of Singapore have now found a way to boost the performance of MoS2 photodetectors even further—with nanoparticles of gold. They describe this improvement in the journal *Applied Physics Letters*, which is produced by AIP Publishing.

Wei Chen, an assistant professor of chemistry and physics, along with graduate student Jia Dan Lin, and their colleagues, applied a single, loosely arranged layer of gold nanoparticles to the top of a MoS2 photodetector. The gold layer, although less than 15 billionths of a meter thick (representing the diameter of each individual nanoparticle) and made up of fewer than 1000 individual particles, improved the photodetectors' efficiency by a factor of three, according to Chen.

"We anticipate orders of magnitude higher improvement of MoS2's sensitivity using a higher density of coated nanoparticles," Chen said.

Chen suspects that the plasmon oscillations (variations in the electron density) of individual nanoparticles—which enhance the local optical field—may be one reason for the improved performance of the photodetectors.

"The next step will focus on varying the materials used to make the nanoparticles, as well as their size, shape, and arrangement," Chen noted—adjustments that will "tune" the plasmon resonance wavelength of the metal nanostructure arrays, making it possible for MoS2 photodetectors todetect multiple colors for the first time.

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