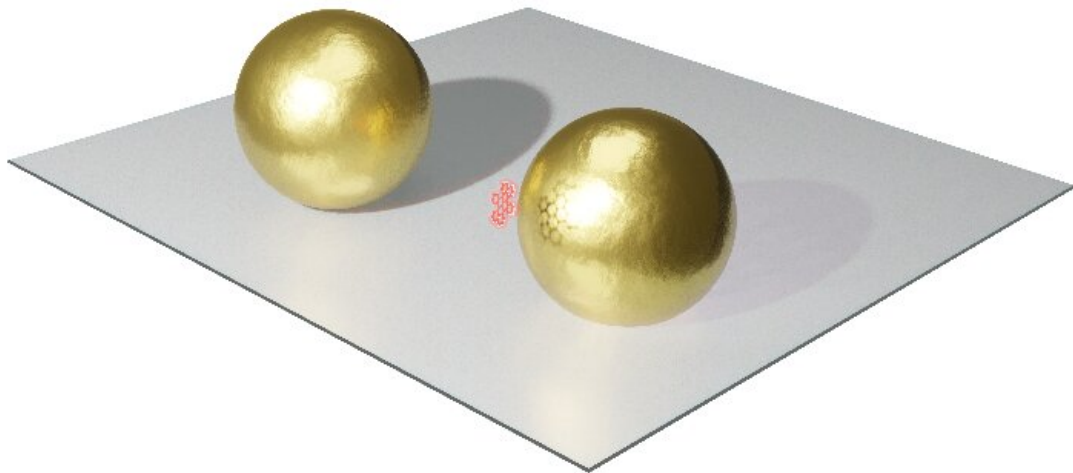


A gold nanoparticle nearly cloaked by a single molecule

September 9 2020, by Bob Yirka



Shadow stealer. The absorption of light by a gold nanoparticle is reduced—and the shadow weakened—when a dye molecule (red) is placed nearby. With experimental improvements, the nanoparticle could become transparent. Credit: J. Zirkelbach/Max Planck Inst. for the Science of Light, via *Physics*, DOI: 10.1103/Physics.13.141

A team of researchers from the Max Planck Institute for the Science of Light and Friedrich-Alexander University Erlangen has found a way to prove a theory suggesting the possibility of cloaking a nanoparticle using a single molecule—by nearly doing it with a gold nanoparticle and a

dibenzoterrylene molecule. In their paper published in the journal *Physical Review Letters*, the group describes their experiments with coupled nanoparticles and molecules, and what they learned from them.

For several years, scientists have been experimenting with coupling [nanoparticles](#) and molecules. In most such work, the nanoparticle (which is generally larger than the molecule) serves as an antenna of sorts, funneling light to the molecule. The goal has been to boost the emissions from the molecule or to absorb the light they receive—both of which can be used to detect biomolecules under certain circumstances. In other work, researchers have looked into the possibility of controlling the emissions coming from the molecule to match the wavelength of the incoming [light](#). In theory, if they are in phase, the nanoparticle's shadow should dissipate or disappear completely—a form of cloaking. In this new effort, the researchers sought to prove this theory by carrying out experiments with nanoparticles and molecules.

The work involved first getting a 130-nm-wide gold nanoparticle to couple with a dibenzoterrylene molecule. This involved placing several of the [gold nanoparticles](#) on a surface and then covering them with a solution containing dibenzoterrylene [molecules](#). The setup was then chilled to the point that the solution solidified. The team then used a laser to look for a test nanoparticle-molecule pairing until they found a pair that had closely coupled. They then focused a near-infrared beam on the pair, from the direction of the molecule.

Notably, the molecule was significantly smaller than the nanoparticle. Still, the close coupling was enough to reduce the shadow of the nanoparticle by 10%. The researchers suggest that better control of the placement of the molecule and nanoparticle would further reduce the shadow, perhaps enough to make it disappear completely. They further suggest that their results open the door to using similar pairs as switches in photon-based circuits.

More information: Johannes Zirkelbach et al. Partial Cloaking of a Gold Particle by a Single Molecule, *Physical Review Letters* (2020). [DOI: 10.1103/PhysRevLett.125.103603](https://doi.org/10.1103/PhysRevLett.125.103603)

© 2020 Science X Network

Citation: A gold nanoparticle nearly cloaked by a single molecule (2020, September 9) retrieved 27 April 2024 from <https://phys.org/news/2020-09-gold-nanoparticle-cloaked-molecule.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.