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Research Highlights

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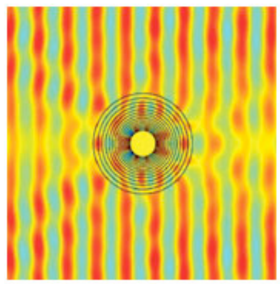
Hyperentanglement, delayed images, exciton logic, and more

Metamaterials

Veil the visible

Opt. Lett. Doc. ID: 94218 (2008)

Electromagnetic cloaking is one of the exciting phenomena possible with metamaterials that have a negative permittivity and permeability. Although cloaking in the microwave frequency range has been achieved experimentally, the extension to visible frequencies is hampered by the difficulty in varying the magnetic permeability. Now, Igor Smolyaninov and co-workers from the University of Maryland, USA, show experimentally that two-dimensional plasmonic metamaterials can provide a path to reduced visibility at wavelengths around 500 nm.



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Their idea builds on a previous theoretical design for non-magnetic optical cloaking that treats the electromagnetic field as a scalar variable. The plasmonic metamaterial was composed of concentric rings of polymethylmethacrylate (PMMA) deposited on the surface of a gold film. An external laser operating at 532 nm illuminated the device. At wavelengths near 500 nm, PMMA exhibits an effective negative refractive index as perceived through plasmons, whereas the gold/vacuum interface in the spaces between the rings acts as a medium with a positive refractive index. The successive regions of positive and negative refractive index can bend light around the area to be cloaked. The researchers observe the flow of energy around the cloak boundary, with only a very small fraction of the plasmon rays propagating exactly through the centre of the structure. The technique also enables customization: varying the width and spacing of the PMMA rings gives control over the average group refractive index of the multilayer material.

Nanowires

Scaling up

***Nano Lett.* doi: 10.1021/nl080627w (2008)** (http://dx.doi.org.ezp-prod1.hul.harvard.edu/10.1021/nl080627w)

Researchers based in Germany and the USA have come up with a method to mass-produce nanowire photonic and electronic devices. Their approach, which relies on spin-on glass technology, enables nanowire devices to be made in a reliable, cheap and fast way.

In recent years nanowires have become relatively cheap and easy to produce in large quantities. However, the challenge is to assemble nanowires over large areas in a highly parallel, scalable and reproducible manner that lends itself to the construction of integrated circuits. Creating effective electrical contacts to the nanowires is also crucial.

Mariano Zimmler and colleagues use photolithography to define electrical contacts at the top and bottom of the nanowire, and hydrogen silsequioxane (spin-on glass) as a spacer layer between the substrate and the top metallic contact to prevent shorting directly to the substrate. Spin-on glass is attractive because of its stability at high temperatures, etch resistivity and robust mechanical properties.

With this scalable fabrication technique, the team produces single-nanowire heterojunction diodes that use p-doped silicon as the substrate and n-doped zinc oxide nanowires. The diodes exhibit good rectification properties and, thanks to the bandgap of zinc oxide, emit UV light. The method can be applied to nanowires with arbitrary cross-sections and doping types, and could lead to unprecedented mass-production of nanowire-based optical and electronic circuits.

Quantum optics

Hyperentanglement