Now that the Néel vector determination has been achieved, what lies ahead? Antiferromagnets form the largest class of ordered magnetic materials and thus there is a vast pool of materials to choose from, but many antiferromagnets are unexplored. The proof of principle, shown for CuMnAs, will have to be confirmed for other antiferromagnets. As the quadratic effect is small — it scales with the square of the relativistic spin–orbit coupling — it is as yet unknown where the detection limits of the technique lie, and thus how well it will work for other nanometre-thin species. Nonetheless, this class of materials sets an exciting playground where new discoveries can be anticipated.

Adopting a broader perspective, the future utilization of antiferromagnets encourages us to think about how the magnetic arrangement of these materials can be controlled and observed. An electric read out of the spin state of CuMnAs has already been achieved[6] with the anisotropic magnetoresistance, an effect that is also proportional to the square of the spin–orbit coupling. Current-induced switching of orientation of the alternating spins in CuMnAs has recently been accomplished[6]. Other ways of fast switching in antiferromagnetic films are now set to be explored, for example, all-optical switching with laser pulses, which might open prospects for unprecedented, fast switching rates. Future research is likely to be geared towards discovering more antiferromagnets that can be optimally switched. In this quest, the magneto-optical approach of Saidl and colleagues could become an indispensable tool for promptly analysing promising materials in the lab. ❐

Peter M. Oppeneer is in the Department of Physics and Astronomy, Uppsala University, S-75120 Uppsala, Sweden.
e-mail: peter.oppeneer@physics.uu.se

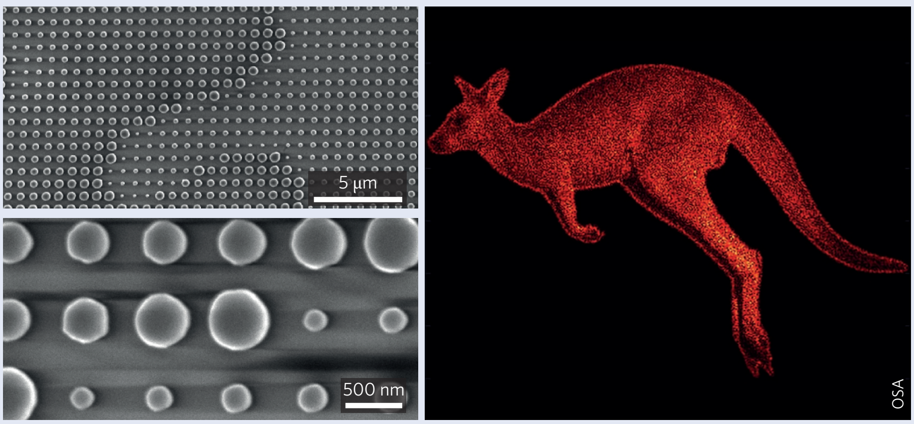
References

1. Saidl, V. *et al. Nat. Photon.* **11,** 91–96 (2017).
2. Baltz, V. *et al.* Preprint at https://arxiv.org/abs/1606.04284 (2016).
3. Jungwirth, T., Marti, X., Wadley, P. & Wunderlich, J. *Nat. Nanotech.* **11,** 231–241 (2016).
4. Kampfrath, T. *et al. Nat. Photon.* **5,** 31–34 (2010).
5. Ferré, J. & Gehring, G. A. *Rep. Prog. Phys.* **47,** 513–611 (1984).
6. Wadley, P. *et al. Science* **351,** 587–590 (2016).
7. Mertins, H.-Ch. *et al. Phys. Rev. Lett.* **87,** 047401 (2001).
8. Nolting, F. *et al. Nature* **405,** 767–769 (2000).

METASURFACES

Efficient holograms

Highly efficient, miniature transparent holograms can be fabricated from dielectric metasurfaces consisting of arrays of silicon nanopillars. That's the achievement of a collaboration between the Australian National University in Canberra, Nanjing University in China and Oak Ridge National Laboratory in the US (*Optica* **3,** 1504–1505; 2016).



Metasurfaces, ultrathin patterned substrates composed of an array of resonant subwavelength-sized elements that alter the phase, amplitude and polarization of incoming light, have become a highly active area of research in recent years. While many designs feature metals and rely on plasmonic effects, several research groups are now designing all-dielectric versions that operate by resonant scattering for realizing a variety of flat, planar optical devices such as waveplates, Q-plates and lenses.

Now, Lei Wang and co-workers report that it is possible to design and fabricate grayscale "metaholograms" that exploit the Mie resonances from dielectric nanostructures and operate in the near-infrared with very high transmission and diffraction efficiency (as shown in the above image of the kangaroo as an example).

"Our metaholograms produce grayscale high-resolution images and transmit over 90% of light with a diffraction efficiency over 99% at a 1600 nm wavelength," say the authors of the paper. "This is the highest efficiency of any metahologram demonstrated to date reproducing grayscale images over a broad spectral range." In this context, diffraction efficiency is defined as the power in the holographic image with respect to the total power transmitted by the metahologram.

The team's metaholograms consist of a dense array of silicon nanopillars of identical height (865 nm) but varying radii (79–212 nm) arranged in a square lattice with 750 nm period and has a total length of 0.75 mm. When illuminated, the metaholograms produce images 5 mm in size at a distance of 10 mm.

The metaholograms are fabricated by depositing poly-silicon on a silica wafer by low-pressure chemical vapour deposition. Electron-beam lithography and refractive ion etching are then used to create the desired nanopillar pattern. Each nanopillar acts as a pixel for the hologram, with a size-dependent phase delay.

The metaholograms have a spectral bandwidth of operation of 375 nm and the team says that the design approach is both scalable to the visible spectral region and potentially compatible with high-index materials such as Ge, GaAs, TiO_2 or diamond.

OLIVER GRAYDON