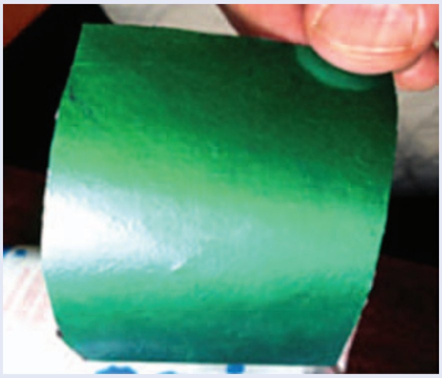
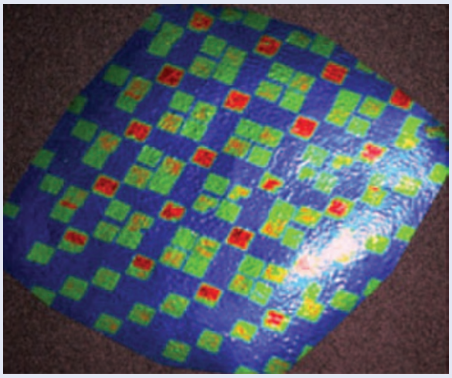
OPTICS

Paper-like mirrors

Scientists in Europe have demonstrated thin, flexible, paper-like mirrors whose polarization and peak wavelength of reflection can be tuned (*Opt. Express* **21**, 20821–20830; 2013). As these narrow-band (bandwidth ~100 nm) reflectors are easy and cheap to fabricate, they are potentially well suited for use in low-cost applications such as e-readers, smart credit cards, labels and dosimeters. They offer an attractive alternative to silver-coated reflectors. Gia Petriashvili and co-workers from the Georgian Technical University (Georgia), University of Calabria (Italy) and Hewlett Packard Labs (UK) made the reflectors by mixing a cholesteric liquid crystal with a reactive monomer (RM 257), an optically active dopant (ZLI-811) and an ultraviolet photoinitiator (Irgacure 2100). A thin layer of the mixture is applied to a paper substrate, and it is covered with a protective polymer film. The entire assembly is then irradiated with ultraviolet light to polymerize it and thereby make it mechanically robust and flexible.





© OSA 2013

Once polymerized, further irradiation with ultraviolet light can be used to change the pitch of the photosensitive cholesteric mixture, and thus tune the spectral response of the mirror's reflection across the visible range — longer durations of ultraviolet exposure give shifts to longer wavelengths. Furthermore, by using a mask during ultraviolet exposure, an array of miniature reflectors with different spectral properties can be realized; for example, a pattern of red, green and blue mirrored pixels can be realized on the one substrate.

The polarizing properties of the reflectors can be controlled by varying the thickness of the polymer cover film, which also acts a phase retarder. In this manner, the reflection polarization can be changed (for example, between linear and circular polarization).

As the reflectors are flexible and tunable, they offer considerable more opportunities for applications that traditionally used silver-coated reflectors. For example, their properties can be tailored to suit any kind of backlight or reflective display design.

OLIVER GRAYDON

TRANSFORMATION OPTICS

Gravitational lens on a chip

Massive objects in space act as gravitational lenses, bending and focusing light. Scientists have now created a photonic analogue of a gravitational lens on a chip, and have shown that it is strong enough to force light into orbits.

Ulf Leonhardt

Sir Arthur Eddington was once claimed to be one of only three people who understood Einstein's general theory of relativity. When informed of this by his colleague, Ludwik Silberstein, Eddington paused and murmured, "I am wondering who the third one is." Now, you have a chance to understand it, too. Writing in *Nature Photonics*, Dentcho Genov and co-workers report an ingeniously simple experiment that recreates Eddington's famous astronomical test of Einstein's theory in the laboratory[1].

The story goes back to 1919 when Eddington led an expedition to the island of Príncipe off the west coast of Africa to observe the total solar eclipse of 29 May 1919. During the few minutes of such an eclipse, the Moon blocks light from the Sun, causing day to turn to night and the stars to become visible. Eddington took photographs of the stars near the eclipsed Sun. He found that the stars appeared to have shifted from their normal positions by an amount Einstein had predicted based on his general theory of relativity. When Eddington returned to the UK, his findings and those of a simultaneous expedition to Sobral in Brazil created a sensation at the Royal Society. The press became interested and cables of the news reached the USA, where journalists asked scientists for explanations and comments. However, they were unable to find anyone in the country who understood Einstein's theory. In desperation, they summarized the story along the lines of "Professor Einstein says the stars have moved because space is curved. Nobody understands his theory, but Einstein is right."

Now, the experiment demonstrated by Genov and colleagues[1] shows that Eddington's test of Einstein's theory of general relativity is in fact easy to understand. For a start, the apparent movement of the stars from their usual positions during the eclipse has nothing to do with the eclipse itself; rather it is related to the fact that their light paths passed close to the Sun. Without the Moon blocking the Sun, the intense sunlight would have