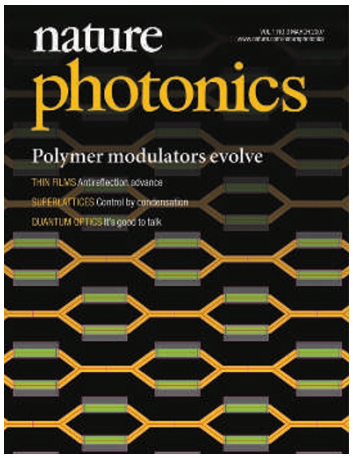


COVER STORY

Vol.1 No.3 March 2007

Electro–optic modulators are important in photonics, offering a convenient method for transforming the output of continuous-wave lasers into short pulses or optical data bits for use in communications. At the heart of such modulators is a nonlinear electro–optic material that changes its refractive index in the presence of an electric field. Until now, most high-performance, commercial devices are based on inorganic electro–optic materials, such as lithium niobate, but the use of polymers is potentially very attractive owing to their promise of high–bandwidth operation, ease of fabrication and low cost. In this issue, Yasufumi Enami and his co-workers report a high-performance hybrid organic–inorganic modulator made by integrating electro–optic polymers with sol–gel waveguides. The device operates at the telecoms window of 1,550 nm and has an outstanding electro–optic coefficient of 170 pm V^{-1} when used as a phase modulator. **[Article p180; News & Views p138]**

WIRING UP THE WORLD

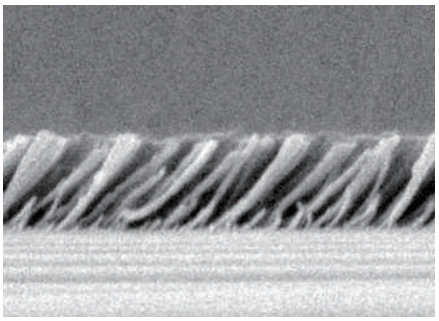
The fact that the globe is now wired with a web of optical fibre is presenting scientists with opportunities for working together in real-time on experiments involving large amounts of data. In the past, the idea of connecting up research groups separated by thousands of miles by means of dedicated 'light paths' that are capable of transmitting many gigabits of data each second would have been unthinkable. Today it is increasingly common and opening the door to distributed grid computing and 'teleworking' on a grand scale. In his commentary, Larry Smarr describes how astronomers, oceanographers, and particle physicists are all benefiting from the latest advances in optical networking. Applications range from passing around vast data sets about ancient galaxies and transmitting live high-definition television feeds from the ocean floor, through to live high-resolution microscopy experiments and the creation of vast video walls containing 200-Megapixel images. **[Commentary p133]**

A NEW WAY TO TALK

Optical communications is a vital part of modern society allowing us to talk, exchange e-mails, surf the Internet, and many applications besides. However, in all of these cases, the amount of light involved in the communication is carefully budgeted to ensure a robust and error-free performance, and as a result each data bit actually contains a large number of photons. Robert Thew and Nicolas Gisin describe life at the other end of the scale in the world of quantum communication. Their review article charts the remarkable progress that has been made in recent years in using single photons and their quantum states to perform a wide range of exciting applications. Topics covered include quantum key distribution (cryptography protected by the laws of physics), information processing, the quantum repeater (an optical amplifier for single photons that preserves their state) and quantum teleportation. **[Review p165]**

AN END TO REFLECTION

Unwanted reflections degrade the performance of a vast number of optical devices, ranging from camera lenses and television screens through to laser-cavity optics and solar cells, to mention a few examples. Although antireflection coatings do exist, they are often limited in their wavelength or angle of operation, and the values of the refractive index that are available. In this issue, Fred Schubert and co-workers report a very-high-performance antireflection coating based on graded layers of ultralow-index material made from SiO_2 and TiO_2 nanorods. By layering several such films, each with a slightly different index onto an AlN substrate, the researchers succeed in creating a coating that operates over the entire visible spectrum and a wide range of angles. The coating includes a layer with an index of 1.05 — the lowest ever reported for a thin film. **[Letter p176; Interview p186]**



SiO_2 nanorod film deposited by oblique-angle evaporation. p176

ULTIMATE CONTROL

Finding efficient and practical ways of controlling light with light is a major challenge, but highly important if researchers are going to succeed in their quest to develop all-optical devices, such as switches, signal processors and computers. Now, Pierre Barthelemy and his colleagues report a phenomenon that might help photonic information processing. They show that it is possible to optically tune the refractive index of a porous material by using a laser to control the amount of gas that condenses within its pores. The findings suggest a new way to achieve all-optical modulation and bistability at low power levels. To demonstrate the effects, the team performed experiments with silicon superlattices, ethanol vapour and infrared laser diodes. They expect that by reducing the volume of the device it should be possible to achieve switching between bistable states on the microsecond regime. **[Letter p172; News & Views p143]**

ORGANIC INVESTMENT

For years scientists have been talking about the potential for making flexible displays or electronic paper, as it is often called. Now it finally looks like the technology is moving towards mass deployment. Plastic Logic, a UK start-up developing flexible organic electronics, is opening a large-scale production facility in Dresden, Germany, to make printable polymer electronics that are ideal for driving such displays. The idea is that Plastic Logic will make the backplane electronics, while E-ink in the USA delivers pioneering image-plane technology based on electronically controlled pigments. Bringing the two together should allow the creation of high-performance displays that are based on plastic substrates and can be flexed or rolled up. Such displays could help give portable electronics a new interface for presenting information, such as navigation data, digital images or pages of text. **[News & Views p142]**

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