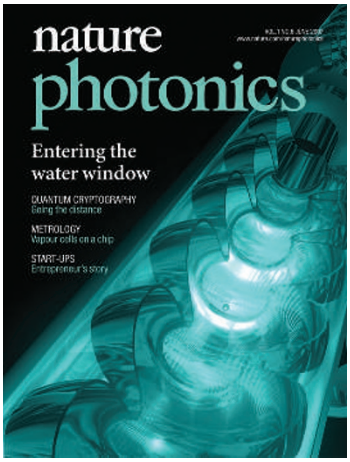


Cover story

Vol.1 No.6 June 2007

Free-electron lasers (FELs) offer an exciting alternative to traditional lasers, generating coherent radiation that is strikingly brilliant, spans a wide frequency range and is, very usefully, continuously tunable. A FEL accelerates a beam of electrons to relativistic speeds in a linear accelerator, and results in an intense beam of polarized short pulses. In this issue, a collaboration of scientists working at the free-electron laser in Hamburg (FLASH) report on their latest achievements. Their laser, with a wavelength of 13.7 nm, operates in the extreme UV range with unprecedented peak and average powers. Moreover, the beam has high harmonic modes with wavelengths down to 2.75 nm, offering access to a part of the spectrum known as the 'water window', which is crucially important for the study of biological systems.
[Article p336; Interview p354]

HACKERS BEWARE

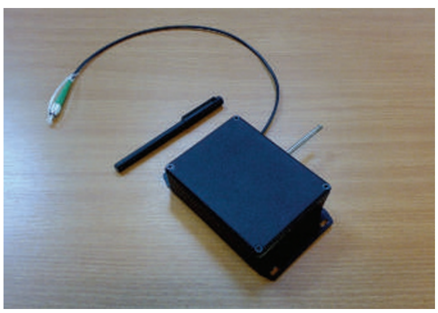
In the world of modern technology and massive information transfer, security is vital. Quantum cryptography offers a way for two parties to communicate securely through the use of quantum 'keys' distributed between them, which protect data-carrying photons during transmission. The challenge is to prevent eavesdroppers from overhearing the conversation by interfering with the information exchanged. In their article, Hiroki Takesue and colleagues in Japan and the USA report on a quantum-key-distribution (QKD) experiment that manages to create secure keys over 200 km of optical fibre, with a 42-dB channel loss. Their achievement represents a doubling of the previous distance record set for ground-based QKD performed over a fibre link. More importantly, by implementing a differential-phase-shift protocol (with a 10-GHz clock frequency) and using superconducting single-photon detectors, the quantum keys can resist general collective attacks on individual photons, as well as specific attacks on multiphotons exchanged between the parties.
[Article p343; News & Views p314]

TWO WORLDS COLLIDE

In this month's review article, José Capmany and Dalma Novak lead us into the world of microwave photonics. For over 30 years, researchers have been interested in the applications that can result from combining the strengths of the radiofrequency domain with those of the optical spectrum. Microwave fibre-optic communication links have a number of advantages over conventional coaxial or waveguide links: they are smaller, lighter, cheaper, undergo low damping and are immune to electrical interference. A key application area is radio-over-fibre systems, in which radio signals are transported efficiently from, say, a central office to a number of distributed antenna stations. Other systems that could take advantage of such technology are cellular networks, wireless local area networks and broadband networks offering very high bandwidths. Microwave photonics is rightfully enjoying a good deal of interest.
[Review p319]

SMART FIBRES

Having transformed the way we communicate with each other, optical fibres are now taking the sensing world by storm. Fibre Bragg gratings operate by reflecting only very narrow wavelength bands of light. Perturbations to the fibre coming from the outside world (changes in temperature, pressure or strain, for example) can be detected as minute changes in the reflected light. Duncan Graham-Rowe talks to a number of companies who are working to exploit this property in fibre-based sensors. From a commercial point of view, the range of applications is enticing: monitoring the structural integrity of buildings, bridges and wind turbines and measuring temperature and pressure in volatile oil wells. These 'smart fibres' can carry signals for miles, reach places other sensors cannot and, as they are not affected by external electromagnetic signals, are expected to give electronic sensors a run for their money.
[Out of the Lab p307]



SMART FIBRES

A prototype fibre Bragg grating displacement sensor.
p307

STARTING UP

Starting something new is always tricky. But as an academic researcher, going out on a limb, taking an idea from the lab and running off with it to set up your own company is a particularly risky challenge. That's just what James Wyant, an optics professor from the University of Arizona, did when he co-founded WYKO with some of his lab colleagues. In this month's commentary article, Wyant shares his story with us. From the difficult balancing act of university work versus commercial work, to a lack of experience in patent law, staff problems and finally cashing out, Wyant tells us of the ups and downs involved. Although not for the faint-hearted, starting your own company can bring freedom and a lot of fun.
[Commentary p301]

THE ROAD TO NANOPHOTONICS

At the Photonics West conference earlier this year, scientists working in the area of nanophotonics gathered together to share ideas. Their aim? To begin forging a cohesive technology roadmap for the field. As Randolph Kirchain and Lionel Kimerling argue, only a concerted and unified effort by those within the field will allow nanophotonics to reach its full technological and market potential. By learning how to control light at the nanoscale, scientists could usher in a new age of ultrasmall, ultrafast optical integrated microcircuits with unprecedented bandwidth. But first the lessons learned by the electronic integrated-circuit industry need to be taken on board. Kimerling and Kirchain hold the opinion that optics should not displace electronics; rather the two should converge. A crucial milestone along the road to nanophotonics will be industry-wide standardization of optical components and coordination across the supply chain.
[Commentary p303]