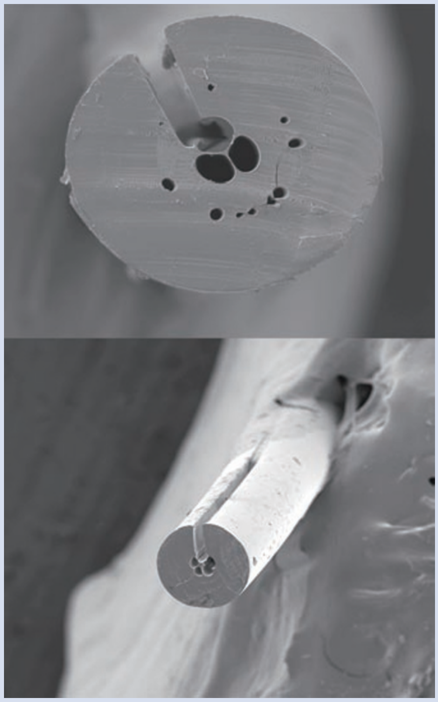
OPTICAL FIBRES

Slot sensors

A design of microstructured optical fibre (MOF) that features a slot running along its length to expose its core could potentially provide a convenient answer to real-time sensing of chemicals and biological agents, according to scientists in Australia and Brazil (*Opt. Express* **15,** 11843–11848; 2007).

Although it is well known that the presence of a liquid or gas in tiny air holes in the cladding of a MOF can be sensed through the effect on the evanescent optical field from the fibre's core, filling the air holes is far from easy. Often capillary action and diffusion are the only options and these are slow processes. In addition, finding ways to simultaneously couple both light and an analyte into the end of a fibre is extremely challenging.

Now Felicity Cox and co-workers from the University of Sydney and UNICAMP may have an elegant answer that offers much more freedom. They have succeeded in creating 140-μm-diameter polymer MOFs with three or five air holes running along the axis and a narrow slot (about 40 μm wide and about 75 μm deep) that provides access to the core. The design allows an analyte instant access to the core at any point along the fibre's length; signal light can be injected through a spliced conventional fibre.



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The slot is naturally created during the fibre-fabrication process. A polymethyl methacrylate preform used to make the MOF is first drawn to a cane and sleeved — that is, a tube is used around the preform to set the fibre's final diameter. Then a series of axial holes (around 1 mm in diameter) are drilled into the cladding of the sleeved cane perpendicular to the cane axis to connect with one of the air holes running along the fibre length. Following a second drawing stage, the holes perpendicular to the cane axis stretch and a MOF with a continuous slot oriented along the fibre axis is formed.

Cox and co-workers conducted a pH test with a three-hole slotted MOF as the sensing element and the indicator bromothymol blue as the analyte.

They used evanescent-wave absorption spectroscopy to monitor the sample as NaOH was added to change the pH. A distinct colour change in the spectra was observed, demonstrating that the slotted MOF can be used as a pH sensor over a range of wavelengths. The researchers foresee that the proposed slot-MOF will be attractive for quasi-distributed sensing and plasmonic-fibre devices.

Rachel Won

ATOMIC SENSORS

Chip-scale magnetometers

A design of laser-pumped magnetometer that combines the properties of alkali metal atoms with fabrication technology from the semiconductor industry could help realize tiny mass-producible devices with high sensitivity and low power consumption.

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Atomic clocks have firmly established themselves as the most precise method of time keeping, but another, equally long-standing metrology application of atoms is high-sensitivity measurements of magnetic fields. On page 649 of this issue[1], Vishal Shah and co-workers report the first steps towards development of a chip-scale atomic magnetometer that can compete with the most sensitive magnetic sensors while requiring very little power. To achieve this impressive performance, the group at the National Institute of Standards and Technology (NIST) in the USA combined recent advances in tunable single-frequency laser diodes and fabrication of millimetre-scale atomic sensors with a few tricks from atomic physics to reduce the negative effects of atomic collisions.

Many physical principles are used in magnetometer designs, from inductive coils and fibre-optics sensors to superconducting devices and specially engineered magnetic materials. This diverse array of sensors is being used for many purposes, from geology and mineral exploration to security, military and medical applications. At present, the most sensitive magnetometers have sensitivities in the femtotesla range (1 fT = 10^{-15} tesla, about 10^{-11} of the Earth's magnetic field) and typically rely on cryogenically cooled superconducting quantum interference devices (SQUIDs) or atomic sensors