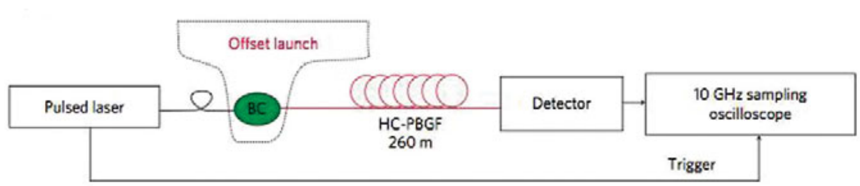
in an unexpectedly high concentration of aluminum atoms uniformly distributed throughout the nanowires." The researchers made their discovery with the aid of an ultraviolet laser-assisted atom probe tomography, which reveals the type and position of each individual atom in nanoscopic samples—see part (b) in the figure.

Oussama Moutanabbir, a professor at École Polytechnique in Montréal, said, "The data surprised us because of the high concentration, on the one hand, and also because the aluminum atoms do not form clusters in the silicon." The number of charge carriers in silicon increases only when the aluminum atoms are distributed uniformly. This increase is important for electronic applications.

In order to understand why more aluminum ends up in the silicon wire than is actually allowed, the researchers developed a model of how quickly the process proceeds on the atomic level. If this time is long, the atoms would arrange themselves until the chemical equilibrium is achieved. However, the time is not long enough for this, and atomic exchange stops as soon as one row of silicon atoms has been completed. "An aluminum atom that has previously been embedded remains permanently trapped," said Moutanabbir. "Until now, it has been assumed that the atoms can be exchanged between the metal drop and silicon until the whole silicon layer is complete." As the researchers have now clarified the process, it should be possible to apply it to the targeted doping of nanowires.

Nano Focus

High-capacity fiber-optic communications at the speed of light uses air as the medium



Time-of-flight experimental setup, where light is launched into 260 m of hollow-core photonic-bandgap fibers (HC-PBGFs) with a 12 mm laterally offset, butt-coupled (BC) standard single-mode fiber. Reproduced with permission from *Nature Photon*. **7** (2013), DOI: 10.1038/nphoton.2013.45; p. 279. © 2013 Macmillan Publishers Ltd.

Improving data transmission across computer networks is key to advancing the performance of modern data centers and massively parallelized supercomputers. Optical fibers provide outstanding transmission bandwidth, but light propagates 31% slower in a silica glass fiber than in vacuum, thus introducing a time delay. Air guidance in hollow-core fibers can improve this significantly, but it has proven challenging to achieve the combined values of loss, bandwidth and mode-coupling characteristics required for high-capacity data transmission.

Addressing this challenge, F. Poletti and colleagues from the University of Southampton have now fabricated hollow-core photonic-bandgap fibers (HC-PBGFs) that are capable of achieving both low surface scattering loss and wide surface-mode-free transmission bandwidth simultaneously (see Figure). This represents the first demonstration of fiber-based wavelength division multiplexed data transmission at close to (99.7%) the speed of light in a vacuum.

As reported in the April issue of *Nature Photonics* (DOI: 10.1038/nphoton.2013.45; p. 279), the team investigated the origin of the observed loss by developing a model of surface scattering in hollow fibers and performing simulations to predict the total loss. This showed that the surface-scattering contribution dominates at the center of the bandgap while confinement loss only reshapes its edges. To gain insight into the modal behavior of HC-PBGFs, the researchers used a combination of time-of-flight (TOF) and self-interferometric measurements (S^2). When the fiber is excited with an offset launch, light is efficiently coupled into several high-order modes. Their lower group velocities relative to the fundamental mode then generate clearly resolvable delayed peaks in the TOF measurement. By cross-comparing results from the TOF and S^2 measurements, the team was also able to identify all expected modes up to LP_{31}. This was attributed to selective excitation of individual polarization modes within a mode group, and the high extinction ratios to relatively low intermodal crosstalk.

The results demonstrate an important step toward the viability of using HC-PBGFs for low-latency data transmission. The achieved loss values are adequate for low latency application, for example, in realization of next-generation peta-to-exaflop scale supercomputers and mega data centers.

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