"Metal-insulator-semiconductor optoelectronic fibres."

Authors: Mehmet Bayindir et al.

Recommended and a Commentary by Claire Gmachl, Princeton University.

Functional optoelectronic components, such as emitters, detectors, or modulators, typically rely on the close integration of semiconductors, metals, and photonic components such as waveguides and resonators. The most common technique for integration is planar, wafer-scale processing followed by dicing and cleaving of the wafer into individual components, that are then reassembled into systems. Much of optoelectronics, furthermore, evolves around fiber optics communication; and thus significant integration effort is devoted to connect the individual optoelectronics components to optical fibers. Being generally costly and time consuming, and in constant need of better solutions, the envelopes of optoelectronics assembly are constantly pushed, be it through the currently thriving chemical self-assembly, or new ways of large area processing.

In their paper "Metal-insulator-semiconductor optoelectronic fibres", M. Bayindir et al. show another intriguing push towards non-planar, fiber-compatible optoelectronics assembly. Specifically, they employ building blocks of optoelectronics that are compatible with fiber pulling, and hence - after assembling these into a fiber perform - pull it into one (1 m - 100's of meter) optoelectronic fiber device.

The components used in pulling the fibers are, first, Sn-wires, for soft, pliable metal strands and electrical contacts; the semiconductors used are several types of chalcogenide glasses, transparent, photoconducting, and amenable to fiber pulling. Finally, the photonic components are omni-directional, photonic bandgap fiber resonators, omni-guide fibers, and low-index polymers.

Together, two types of fibers are demonstrated; first, a hollow-core photonic fiber, with "stockings" of longitudinal Sn wires around it. This fiber guides light with the same low loss as more conventional (non-metallized) omniguide fibers of the same materials; and the metal strands are ohmic.

In a second, significantly more functional approach, the authors combine a photoconducive and optically guiding chalcogenide semiconductor core, surrounded by four Sn wires, and a resonant photonic crystal cavity and shield. This fiber shows a clear photocurrent signal commensurate with the absorption spectra of the absorbing material and the resonance frequencies of the photonic crystal shield.

One day such fiber may be woven into optoelectronically functional fabrics, or be used for straightforward manufacture of detector arrays. Right now it is simply enjoyable to see novel optoelectronic fabrication techniques continue to spring up. It shows the field is vibrant and still very much alive.