in a vacuum to minimize disturbances.

He recalled that, before he built and operated the prototype, he was not sure that this would work because of mechanical and thermal fluctuations in the fiber. In the end, however, it did.

As for applications, he believes that these will be in specialized areas requiring ultrahigh-accuracy displacement measurements. Most will be in national standards laboratories, but it is possible that the approach will be used in demanding industrial applications, he said. □

Hank Hogan

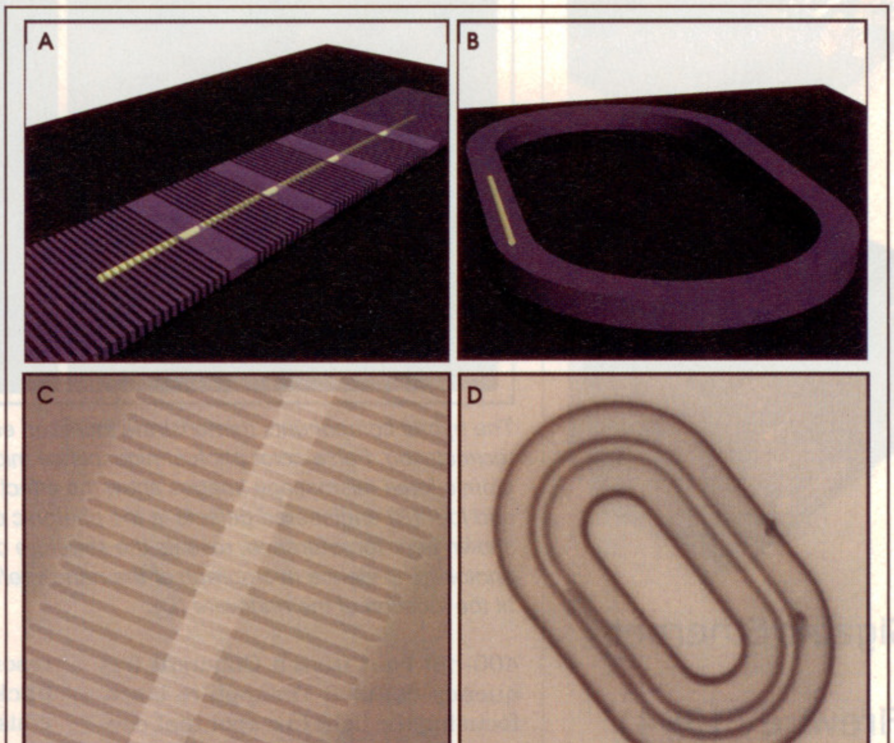
Journal of the Optical Society of America A, December 2005, pp. 2786-2798.

Hybrid Nanowire Components Show Promise for Photonics

Uses envisioned in light sources and in photonic integrated circuits.

To advance the development of ultrasmall nanowire-based photonic devices, a research team at Harvard University in Cambridge, Mass., has incorporated single CdS nanowires into lithographically defined photonic crystal and "racetrack" microresonator polymer structures. The structures enable localized emission from engineered defects and resonant recirculation, respectively.

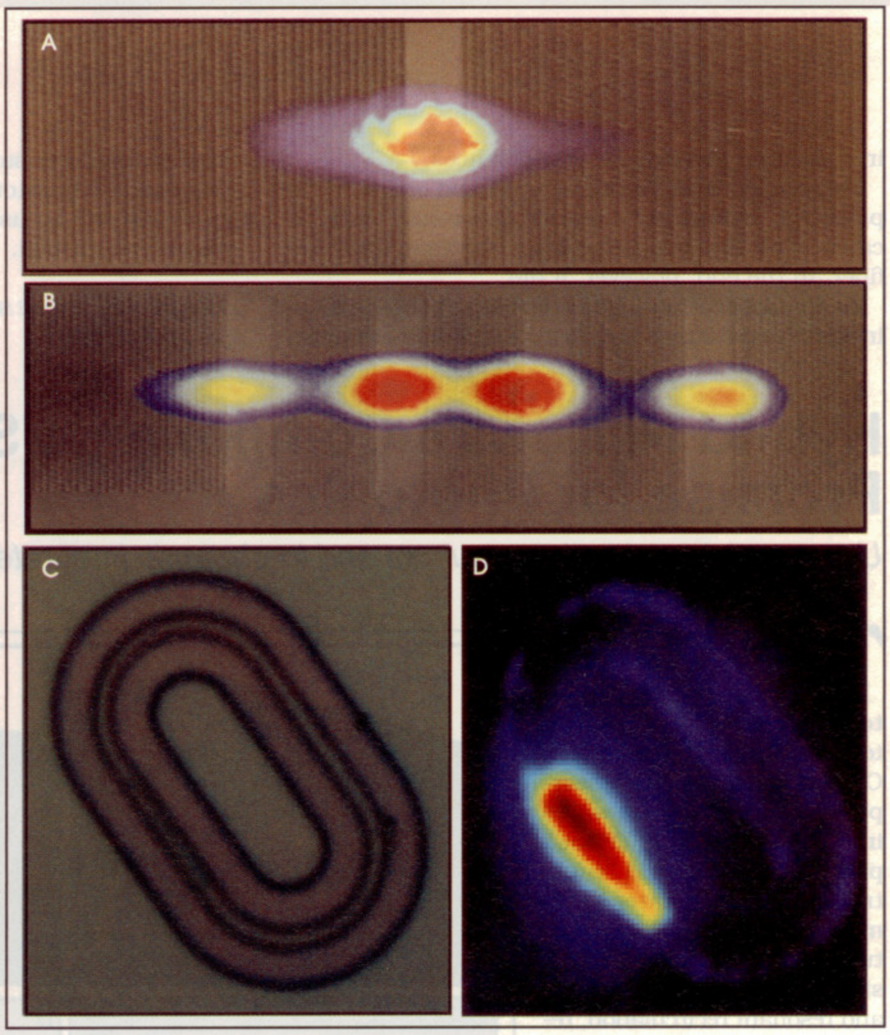
The investigators note that rapid progress has been made in demonstrating that semiconductor nanowires can be employed to produce nanophotonic devices such as LEDs, lasers and electro-optic modulators. A particular challenge facing the integration of these devices to create systems such as photonic integrated circuits, however, involves difficulties coupling light into and out of single nanowires.



Researchers have incorporated CdS nanowires into polymer structures that control their performance. Designs include a nanowire and a 1-D photonic crystal with engineered defects (A) and a nanowire and a "racetrack" microresonator (B). Micrographs show a nanowire and photonic crystal (C) and a nanowire and microresonator (D). Images courtesy of Carl J. Barrelet, Harvard University.

The scientists thus turned to photonic crystals and microcavities. They first sandwiched a CdS nanowire in between 200-nm-thick layers of polymethyl methacrylate on a low-index substrate. They used electron-beam lithography to define patterns in the polymer layers that they had designed employing finite-difference time-domain simulations, and then developed the structures with a brief exposure to a solution of methyl isobutyl ketone.

To compare the performance of the hybrid components with the simulations, they optically pumped the direct bandgap semiconductor nanowires with



The hybrid components demonstrate localized emission and resonant recirculation. False-color photoluminescence micrographs superimposed on atomic force microscope images show the effect on nanowire emission of one (A) and four (B) engineered defects in the photonic crystal. An optical micrograph, shown here for reference, reveals the structure of a microresonator (C). A photoluminescence micrograph of the nanowire/resonator reveals strong emission at the location of the nanowire (D).

400-nm light from a Coherent frequency-doubled Ti:sapphire laser, focusing the light to a spot that covered the length of each wire. They collected the resulting photoluminescence using a 40× or 100× microscope objective, focused it on an Acton Research 300-mm spectrometer, and imaged or dispersed it on a Roper Scientific cooled CCD camera.

The researchers found that 1-D photonic crystals with engineered defects could be used to localize the photoluminescence emission. Measurements of the output power and spectra from the nanowires sandwiched by racetrack-shaped microresonators indicated efficient feedback and amplified spontaneous emission, which the scientists suggest may enable the development of low-threshold external cavity nanowire lasers.

They further suggest that parallel techniques such as holographic optical tweezers (see "Holographic Optical Traps Manipulate and Assemble Multiple Nanowires," *Photonics Spectra*, January, page 130) may be used to arrange such hybrid nanowire components into photonic integrated circuits. □

Daniel S. Burgess

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