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PHOTONICS SPECTRA®

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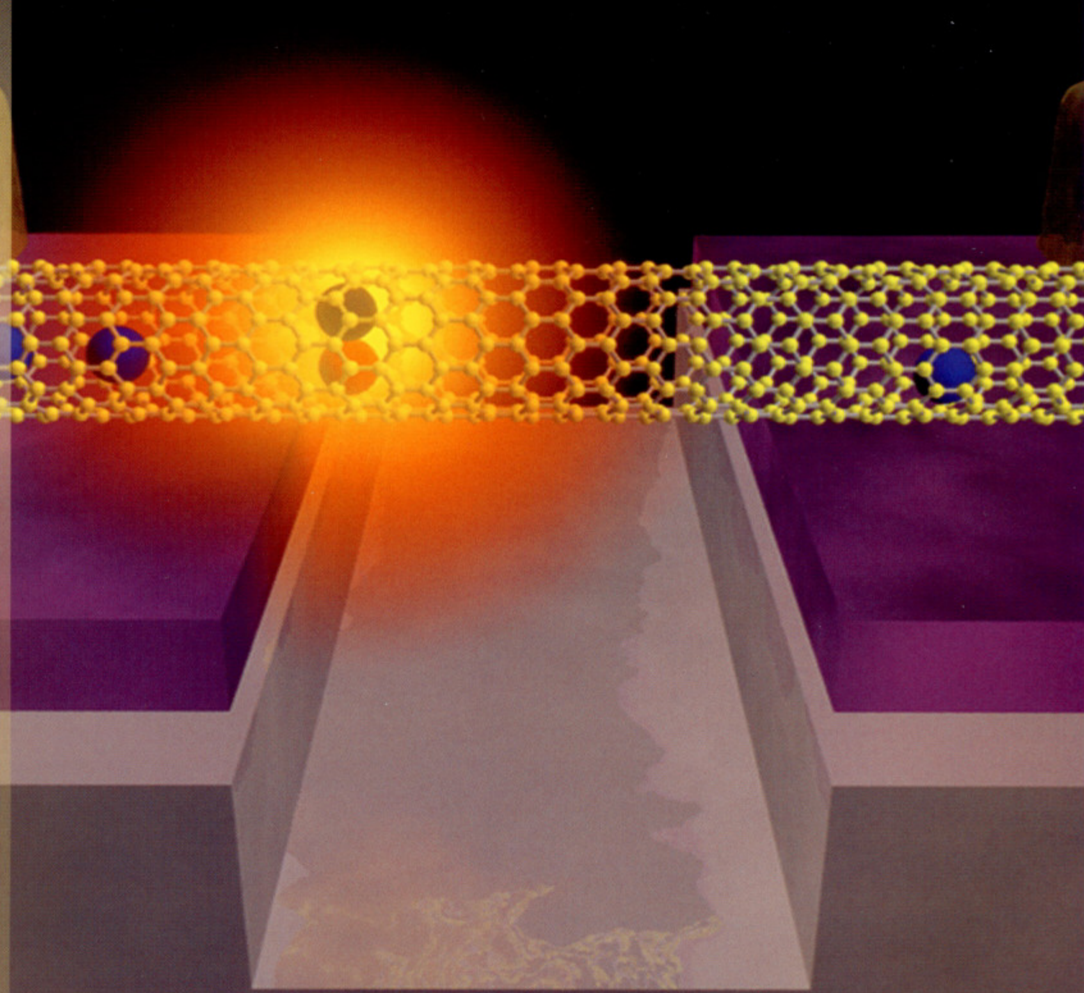
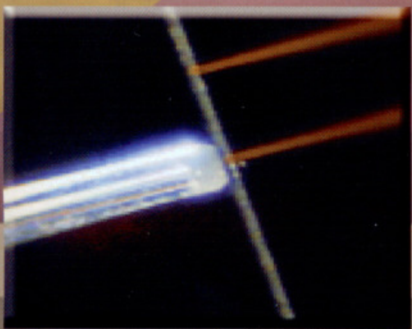
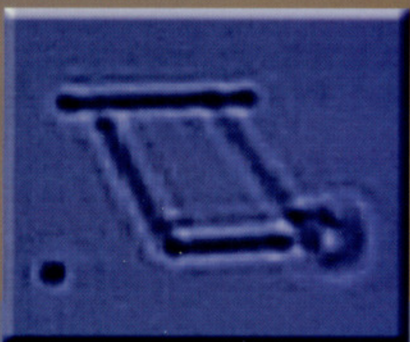






Nanophotonics

Can Photonics Satisfy Moore's Law?

Lasers in Automation

Doping the wide-bandgap semiconductor with transition metal ions was considered as a potential solution, but doing so during the nucleation or growth phases of the synthesis process for trillions of nanocrystals in solution had proved difficult, Peng explained.

Decoupling the doping step from one or both of these phases appears to be the solution. The scientists have developed two approaches: nucleation-doping and growth-doping.

In the former, the dopant and host precursors are mixed during nucleation. The growth phase then is performed under slightly altered conditions such that the dopant precursors become inactive and the host overcoats the doped cores.

In the latter, nucleation takes place as in the standard synthesis process, and growth is permitted to begin. After the formation of small host nanocrystals, however, the reaction temperature is reduced to stop the growth phase. The doping step is performed, and host growth is subsequently reinitiated.

At this point, Peng said, the researchers can produce doped ZnSe nanocrystals that emit at between 450 and 600 nm, although work must be done to narrow their emission bands. The structures are environmentally and thermally stable, displaying no substantial quenching of emission upon exposure to air, pyridine, thiols, ultraviolet radiation and temperatures of more than 200 °C. Reabsorption and energy transfer do not appear to be an issue in the doped structures as a result of their relatively large Stokes shift.

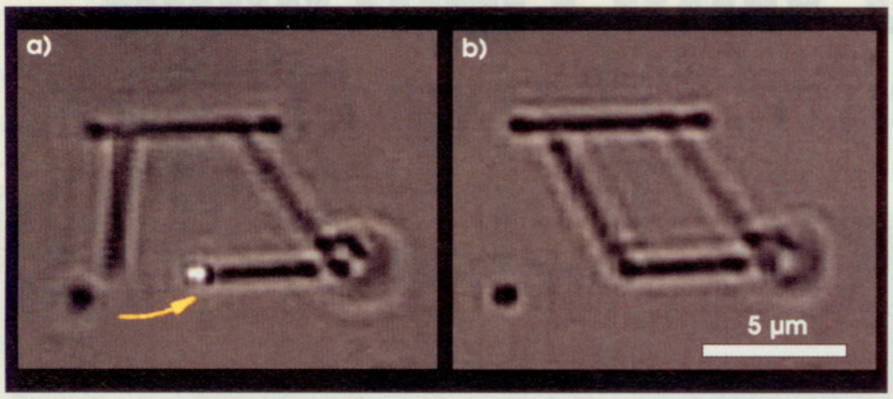
The scientists will explore the relationship between the synthesis process and the performance of the doped nanocrystals and will work to develop other hosts and dopants. They also are curious to investigate how the nanocrystals will perform in various devices, Peng said. □

Daniel S. Burgess

Journal of the American Chemical Society, Dec. 21, 2005, pp. 17586-17587.

Holographic Optical Traps Manipulate and Assemble Multiple Nanowires

In the nanoworld, loads of devices can be packed into a small area. But to get them there, these tiny objects must be organized into a structure, which is not easy to do with lithographic methods or even with optical tweezers. To address this challenge, researchers at Harvard University in Cambridge, Mass., and at New York University have developed a holographic approach to nanoassembly that enables the simultaneous manipulation of multiple nanowires.



Nanowires can be cut (a), bent and fused (b) with intense, focused beams of light. Courtesy of David G. Grier.

The scientists used a holographic trapping technique that they originally demonstrated by shining a beam of light through an inexpensive toy that they had ordered from a scientific surplus catalog. What was originally a 4 × 4 array generator turned out to be effective for creating arrays of optical traps, explained David G. Grier, a member of the team from New York University.

After that, they turned to computer holography and started projecting sequences of holograms with spatial light modulators, producing several hundred traps from a single beam of light. They have patented this technique, which forms the basis of the product offerings of Arryx Inc. in Chicago.

In their current work, the researchers had the goal of trapping 20- to 100-nm-diameter semiconductor nanowires using 400-nm light. "[It] is like trying to grab spaghetti with an oven mitt," Grier said.

To prevent the nanowires from sticking to any surface, they used a chemical stabilization process. Getting the structures to stay in place after stabilization became a challenge, however, so they also employed optical and chemical destabilization to make the nanowires stick where they wanted them.

Using the holographic trapping method, they trapped 10 to 20 nanowires at a time and manipulated the structures in 3-D relative to each other into interesting configurations. It worked so well that their next step is to understand why, so they can optimize it. □

Anne L. Fischer

Optics Express, Oct. 31, 2005, pp. 8906-8912.