zero. In this way, the information in the probe pulse is "mapped" into the atomic coherence of the material, and can be read out subsequently by turning the coupling laser on again. The ability to store and recover the coherent light wave depends upon the spin coherence of the system as well as decoherence effects.

Since the initial "ultraslow" light observations in "cold" and "hot" atomic gases and subsequent extensions to "trapping" light, there has been considerable speculation regarding potential applications such as quantum computing, novel optical devices, and advanced measurement techniques. Nevertheless, the gaseous nature of the light-trapping medium has posed an obvious practical limitation for a variety of these uses. The researchers believe that their use of a solid-state medium opens the door to potential practical applications that had previously not been feasible from a materials perspective. However, all of the work reported here has been performed on samples held at a temperature of 5 K. Practical applications may require operation at much higher temperatures.

EMILY JARVIS

### Electromagnetic Field Guides Flow through Microfluidic Networks

Nonspecific binding to channel walls and particle clogging of microchannels are key obstacles that limit the application of microfluidic lab-on-a-chip technologies. In the February 25 issue of *Applied Physics Letter*, researchers G. Zabow and colleagues at Harvard University described a technique that allowed guided flow of particles through microchannels, even through those with arbitrary geometries, without particle adhesion to channel walls.

The technique was an electromagnetic guided approach to attract transported particles toward the channel centers and eliminate particle adhesion to channel walls, control particle spreading due to Poiseuille flows, prevent gravitational settling, and provide a means for rapid particle separation. A net force was applied on the particles and was defined by the applied electromagnetic force in conjunction with surface-tension constraints inherent to the microfluidic capillary network. The researchers said that for interfaces (liquid–liquid or liquid–gas) with a nonzero curvature, or a field with a nonzero curvature over the surface defined by the liquid interface, net forces parallel to the surface resulted that could be exploited to direct particle flow. Such curved fluid interfaces were achieved by forming fluid channels from complementary molds with the bottom and top half hydrophilic and hydrophobic, respectively. The pressure difference across the fluid surface set the liquid-wall contact angle, θ, and surface curvature and was readily controlled through fluid flow velocity, gas pressure, or channel width. For fluid contact angles $\theta > 90°$, the interface bulged upward in the center, creating a local electromagnetic potential minimum where the particles accumulated. Conversely, for $\theta < 90°$, the interface lowered in the center, and particles moved toward the channel walls. Rapid particle separation of the ongoing stream was possible by switching from $\theta > 90°$ to $\theta < 90°$.

The researchers considered an annular ring with a large radius to prove their claims both numerically and experimentally. They modeled the fluid surface profile by solving a differential equation that included the effects of the difference in density of the fluids, the fluid surface tension, and gravitational effects. They then overlaid the profile with a density plot of applied magnetic field. To test the theory, experiments were conducted with a transparent poly(dimethylsiloxane) ring channel (4-mm width) and 4.5-μm-diameter superparamagnetic beads. The results showed excellent agreement with theoretical predictions, with the same beads flowing at the channel center and around the ring for 1000 s (orders of magnitude longer than typical microfluidic times). Also, the system could be operated as a filter or separator by slowly reducing the contact angle from $\theta > 90^\circ$ to $\theta < 90^\circ$. The capillary length scale (4 mm in the case described) was determined by the ratio of surface tension to gravitational weight. This microfluidic channel width of 4 mm sets the approximate upper size limit; however, as microfluidic sizes shrink, the effect becomes more efficient, and similar behavior was observed over all widths down to 100 µm.

SHILPA SANKHE

## Discretely Sized Si Nanoparticles Fluoresce in RGB Colors

Researchers at the University of Illinois at Urbana-Champaign have demonstrated that their electrochemically etched hydrogen-capped silicon ($Si_nH_x$) nanoparticles ($n > 20$) come in particular sizes (including diameters of 1 nm, 1.67 nm, 2.15 nm, and 2.9 nm) and fluoresce in blue, green, yellow, and red, respectively, with band peaks at ~410 nm, 540 nm, 570 nm, and 600 nm. To convert bulk silicon into nanoparticles, physics professor Munir Nayfeh and his colleagues used an electrochemical treatment that involved gradually immersing a silicon wafer into an etchant bath of hydrofluoric acid and hydrogen peroxide while applying an electrical current. The process eroded the surface layer of the material, leaving behind a network of weakly interconnected nanostructures. The wafer was then removed from the etchant and immersed briefly in an ultrasound bath.

Under the ultrasound treatment, the nanostructure network crumbled into individual particles, which could be easily separated into the different size groups. According to the authors, quantum Monte Carlo simulations indicate that the key to forming these stable configurations is the use of hydrogen peroxide in the etching solution. Although the authors do not have a full understanding yet, it appears that the hydrogen interacts with the Si and etching solution in such a way that formation of certain configurations are energetically favored. As reported in the February 4 issue of *Applied Physics Letters*, the silicon particles fluoresced under ultraviolet light. They also could fluoresce when struck with two photons of infrared light, a technique that could noninvasively penetrate human tissue.

Current medical and biological fluorescent imaging is limited by the use of dye markers, which are not photostable, Nayfeh said. The dyes can break down under photoexcitation, room light, or higher temperatures. The Si particles are photostable and bright.

"By placing particles of different colors in strategic locations, you could study such phenomena as growth factors in cancer cells or how proteins fold," said Nayfeh, who also is a researcher at the UI's Beckman Institute for Advanced Science and Technology.

## DNA Strands Control and Fuel Robust DNA Rotary Mechanical Device

A team of researchers at New York University has built a device from synthetic DNA molecules that improves upon previously developed nanoscale DNA devices because it allows for better-controlled movement within larger DNA