chased PS beads were functionalized with a submonolayer of 10–20-nm-diameter silver nanoparticles using a commercially available electroless silver-deposition kit. The beads were poured into a cell consisting of two glass substrates spaced 10–70 µm apart. Titanium (IV) isopropoxide in isopropanol was then added to the cell, and the assembly was exposed to air to hydrolyze the titanium isopropoxide to amorphous titania. The PS beads were then dissolved in toluene, and the remaining hollow titania shells were released from the glass substrate by sonication.

The researchers demonstrated the versatility of this method for the titania shell/silver-nanocrystal system by preparing hollow shells with void sizes of 0.38 µm and 1 µm by using PS beads with different diameters. The shell thickness was also varied from 30 nm to 170 nm by increasing the concentration of the isopropoxide precursor. The void sizes and shell thicknesses of the hollow spheres were confirmed by transmission and scanning electron microscopy. These micrographs also showed that the silver nanocrystals were securely embedded in the walls of the spheres. The spheres were found to be robust enough to maintain their shape throughout the templating and post-treatment processes.

The researchers believe that this synthetic method can be extended to prepare functionalized hollow spheres having a large variety of core materials and inner surface microstructures. Also, hollow spheres with voids in the walls could be prepared by removing the functionalities through wet etching or calcination. The researchers said that a particularly exciting application involves decorating the inner surface with a catalyst and using the wall of the hollow sphere to control the diffusion of substrate and product species of the catalytic process.

In the March 15th issue of Optics Letters, experimental results were presented by researchers from the Hanscom Air Force Research Laboratory, Massachusetts Institute of Technology, and Texas A&M University, showing Raman-excited spin coherences in the nitrogen-vacancy (N-V) color center in diamond. This material was chosen because of its large optical oscillator strength (~0.1), its relatively long spin-coherence lifetimes (1–100 µs range), and its previous exhibition of Raman heterodyne signals. The diamond sample had ~30 parts in 10^9 N-V color centers.

A magnetic field was applied in the (111) orientation of the N-V centers as laser beams at different frequencies were focused into the crystal. The beams originated from one dye laser output that had been shifted with the use of acousto-optic frequency shifters. A nondegenerate four-wave mixing (NDFWM) signal was generated and analyzed as a function of Raman laser-beam intensities in order to determine the saturation curve. The linewidth was then measured at intensities well below the saturation limit. The ~5.5 MHz linewidth indicated that the signal was due to the Raman process.

By reducing the intensity of one beam and using it as a probe, and increasing the intensity of another beam to its maximum intensity and using it as a coupling beam, EIT was observed in the sample. The NDFWM beam was blocked during this experiment. A maximum transparency of 17% was reached, which corresponds to about 70% of what is possible, considering that only one out of four N-V centers are oriented in the (111) direction. A fit to the EIT spectrum gives a Rabi frequency of ~160 MHz.

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