Licensable Technologies

Magnetic-Optical Nanoparticles

Applications:

- Next-generation bioassays
- Reversible sample aggregators
- Spintronics spin injectors
- Magnetic field modulators

Benefits:

- Simultaneous optical identification and magnetic manipulation
- Tunable blocking temperatures
- Low-temperature blocking temperatures
- Sample separation after collection is enabled
- Improved spin injector efficiencies
- Photoluminescence controlled via magnetic fields

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Summary:

Los Alamos National Laboratory (LANL) researchers have developed the first all-inorganic magnetic-optical composite nanoparticles that combine the properties of magnetic nanoparticles and semiconductor quantum dots. These nanocomposites have a core/shell structure with a magnetic core and a semiconductor shell. Although the nanocomposites retain the optical and magnetic properties of the component parts, these properties are altered by the core/shell structure in useful ways. For example, the blocking temperature (super-paramagnetic to ferromagnetic transition) of the magnetic core has been shown to drop significantly in the core-shell structure. This lowered transition temperature creates the potential for tunable blocking temperatures and reversible sample aggregation near room temperature. In addition to changes in magnetic behavior relative to magnetic nanoparticles, the photoluminescence dynamics of the nanocomposites are also changed relative to the optical properties of similarly sized quantum dots.

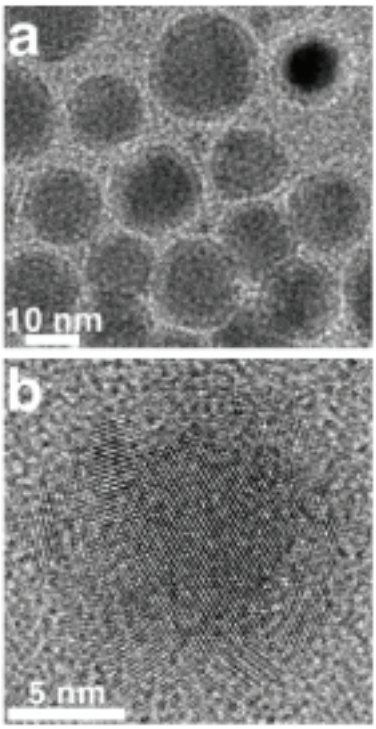

Figure 1. (a) TEM image of Co/CdSe core/shell nanocomposites. (b) Highresolution TEM image of a composite nanocrystal revealing the polycrystalline nature of the shell.

An important application for the new nanocomposites is in next-generation bioassay and tagging methods. These new nanocomposites combine an optical label with a magnetic handle for sample collection. While previous magnetic handles suffered from a lack of reversibility and sample clumping, the tunable blocking temperature of these nanocomposites enable reversible sample aggregation and separation. The nanocomposites may also find utility in spintronics as spin injectors with significantly higher efficiencies compared with existing injectors. It is also expected that the nancomposites will be used in magnetic field modulators where the photoluminescence is controlled via applied magnetic fields.

Reference:

H. Kim, M. Achermann, L. Balet, J. A. Hollingsworth, and V. I. Klimov, "Synthesis and Characterization of Co/CdSe Core/Shell Nanocomposites: Bi-functional Magnetic-Optical Nanocrystals," *J. Am. Chem. Soc.* 127, 544 (2005).

Development Stage:

This technology has been reduced to practice; however, application-specific refinement may be necessary.

Patent Status: Patent pending

Licensing Status:

This technology is available for exclusive and non-exclusive licensing.

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