Internal Labeling Technique Tracks Nanoparticle Transport

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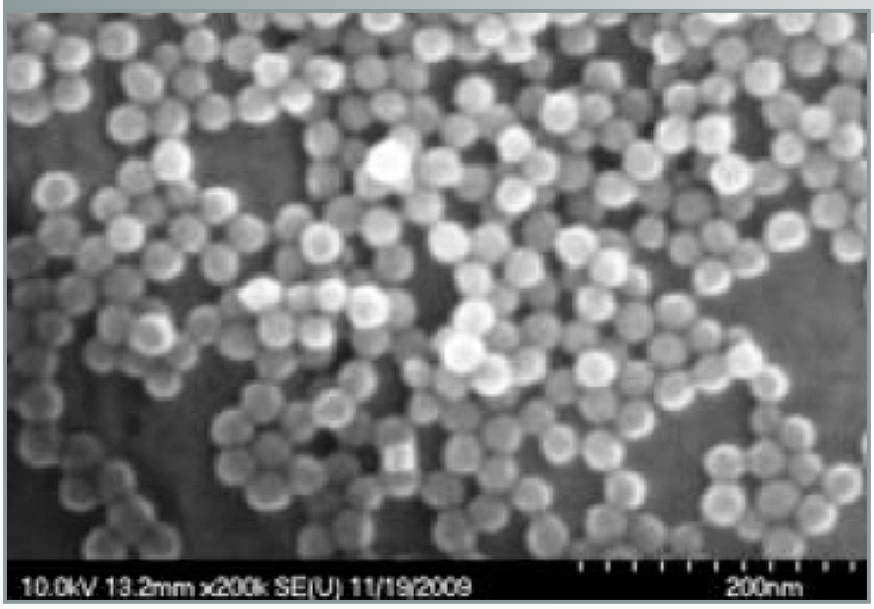

Technology Summary

To track the transport of nanoscale particles and core-shell particles in biological and environmental systems, ORNL researchers developed a way to insert a radioisotope or a fluorophore into the particle as an observable marker. Internalized labeling of nanoparticles leaves the surface intact and available for functionalization with a host of species. No other comparable option for labeled nanoparticles is currently available.

Conventional approaches to surface labeling can cause markers to degrade and become detached. MRI and magnetic particle imaging are currently used to track superparamagnetic nanoparticles in organisms, nanoshells for thermal therapy of tumors, and magnetic nanoparticles for drug and gene delivery. Unfortunately, compatibility of such nanoparticles and shells with multiple imaging/tracking methods is rare.

The ORNL invention consists of "volume labeling," or incorporating, a radioisotope or a fluorophore into an organic, inorganic, or hybrid nanoparticle. The nanomaterials can include metal or semi-metal oxide (e.g., silica), quantum dot, noble metal, magnetic metal oxide, organic polymer, metal salt, and core-shell nanoparticles. In the organic fluorophores, the internalized labeling protects the fluorophore, providing a highly stabilized fluorescence.

Advantages

- Nanoparticles surfaces are free for functionalization with a host of species
- SiO_2 nanoparticles have controllable sizes and surface properties
- Observable markers are less prone to detachment, permitting detection and tracking over long periods
- Volume labeling protects the fluorophore from dye leakage and photobleaching
- Improved fluorescence is particularly beneficial in biological tissue targeting and staining
- Process allows the combination of a variety of core shell particles with multiple functionalities

Potential Applications

- Contrast imaging techniques, therapeutic delivery agents, biological labeling and cancer diagnostics, industrial fillers and additives, and catalysts and fuel additives
- Nanoparticle distribution in systems with both indirect exposure (occupational exposure, or release into environment) and direct exposure (pharmaceutical delivery, cancer diagnostic, image contrast)
- Approval/regulatory processes that will require particle testing prior to commercial use

Patent

Mitchel J. Doktycz, Baohua Gu, Scott T. Retterer, and Wei Wang, *Volume labeled Nanoparticles and Methods of Preparation*, U.S. Patent Application 12/981,886, filed December 30, 2010.

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