Mass-Producing Tunable Magnetic Nanoparticles

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Taking a cue from the semiconductor industry, a team of investigators at Stanford University has developed a method of producing unlimited quantities of highly magnetic nanoparticles suitable for use as magnetic resonance tumor imaging agents.

Equally important, this method can be easily tailored to produce nanoparticles with a wide range of well-defined magnetic properties. Tunability creates the opportunity to use these nanoparticles in multiplexed biosensing applications akin to those now being developed using tunable quantum dots of multiple colors.

Shan Wang, Ph.D., a member of the Center for Cancer Nanotechnology Excellence Focused on Therapy Response, one of eight Centers of Cancer Nanotechnology Excellence (CCNEs) funded by the NCI, led a research team that has been exploring methods of creating large, uniform batches of magnetic nanoparticles. Their current work, reported in the journal *Advanced Materials*, describes a technique for fabricating magnetic nanoparticles that involves forming two magnetic layers sandwiched around a layer of nonmagnetic material.

To create these sandwich particles, the investigators use a technique known as nanoimprint lithography to create cobalt-iron nanodisks. As a nonmagnetic spacer, the researchers used nanometer-thick layers of ruthenium. By varying the thickness of the ruthenium spacer layer, the investigators found they could alter the magnetic properties of the resulting nanodisks in a predictable manner. The disks are coated with a

thin layer of tantalum to stabilize them.

In addition to producing nanoparticles with tunable magnetic properties, the researchers showed that they could use nanoimprint lithography to add additional layers of materials that afforded the resulting disks with other useful properties. For example, the investigators added a layer of gold onto the tantalum surfaces, creating magnetic nanoparticles that could also be detected using surface plasmon resonance imaging, a sensitive optical imaging technique.

This work, which was supported by the NCI's Alliance for Nanotechnology in Cancer, is detailed in the paper "High-Moment Antiferromagnetic Nanoparticles with Tunable Magnetic Properties." There is no abstract available for this paper, but a citation is available at the journal's Web site.

Source: National Cancer Institute