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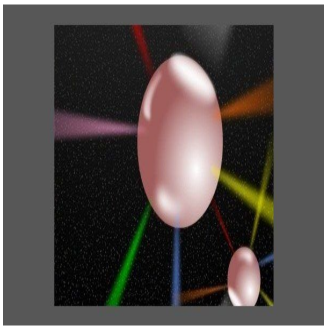
# 1 Nanoparticle = 6 Types of Medical Imaging



Researchers have created a nanoparticle that can be detected by six medical imaging techniques: computed tomography (CT) scanning, positron emission tomography (PET) scanning, fluorescence imaging, photoacoustic imaging, upconversion imaging and Cerenkov luminescence imaging. In the future, patients could receive a single injection of the nanoparticles to have all six types of imaging done.

Although a machine capable of performing all six imaging techniques at once has not yet been invented, the researchers hope that discoveries like theirs will spur development of such technology. This kind of "hypermodal" imaging would allow physicians to see a much clearer picture of patients' organs and tissues than a single method alone could provide. It could help clinicians diagnose disease and identify the boundaries of tumours.

"This nanoparticle may open the door for new 'hypermodal' imaging systems that allow a lot of new information to be obtained using just one contrast agent," said researcher Jonathan Lovell, PhD, assistant professor of biomedical engineering, University at Buffalo. "Once such systems are developed, a patient could theoretically go in for one scan with one machine instead of multiple scans with multiple machines."

Using the nanoparticles to examine the lymph nodes of mice, Lovell and colleagues found that CT and PET scans provided the deepest tissue penetration, while the photoacoustic imaging showed blood vessel details that the first two techniques missed. Differences like these mean clinicians can get a much clearer picture of what is happening inside the body by combining the results of multiple modalities, the research team noted.

The team designed the nanoparticles from two biocompatible components: An "upconversion" core that glows blue when struck by near-infrared light, and an outer fabric of porphyrin-phospholipids (PoP) that wraps around the core. Each part has unique characteristics that make it ideal for certain types of imaging:

- The core, initially designed for upconversion imaging, is made from sodium, ytterbium, fluorine, yttrium and thulium. The ytterbium is dense in electrons, a property that facilitates detection by CT scans.
- The PoP wrapper has biophotonic qualities that make it a great match for photoacoustic and fluorescence imaging. The PoP layer also is adept at attracting copper, which is used in PET and Cerenkov luminescence imaging.

The study is published online in the journal *Advanced Materials*. It was led by Lovell; Paras Prasad, PhD, executive director of UB's Institute for Lasers, Photonics and Biophotonics (ILPB); and Guanying Chen, PhD, a researcher at ILPB and Harbin Institute of Technology in China. The team also included additional collaborators from these institutions, as well as the University of Wisconsin and POSTECH in South Korea.

More studies are needed to determine whether the nanoparticle is safe to use for the intended purposes, although Prasad noted that "it does not contain toxic metals such as cadmium that are known to pose potential risks and found in some other nanoparticles." Prasad is also a SUNY Distinguished Professor of chemistry, physics, medicine and electrical engineering at UB.

The next step in the research is to explore additional uses for the technology. For example, it might be possible to attach a targeting molecule to the PoP surface that would enable cancer cells to take up the particles, something that fluorescence and photoacoustic imaging can detect given the properties of the smart PoP coating. This would enable physicians to better see where tumours begin and end, Lovell said.

Source: University at Buffalo
Image Credit: Jonathan Lovell/University at Buffalo

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