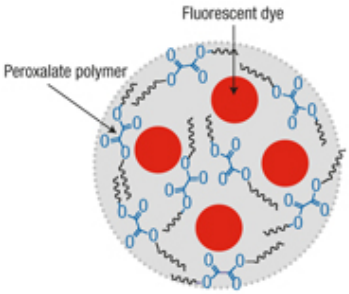
Nanoparticle Could Help Detect Many Diseases Early



The nanoparticle polymer is made of peroxalate esters. A fluorescent dye (pentacene) is then encapsulated into the polymer. When the nano particles bump into hydrogen peroxide, they excite the dye, which then emits photons (or light) that can be detected. Credit: Georgia Tech

Most people think of hydrogen peroxide as a topical germ killer, but the medicine cabinet staple is gaining steam in the medical community as an early indicator of disease in the body.

Georgia Institute of Technology and Emory University researchers are the first to create a nanoparticle capable of detecting and imaging trace amounts of hydrogen peroxide in animals. The nanoparticles, thought to be completely nontoxic, could some day be used as a simple, all-purpose diagnostic tool to detect the earliest stages of any disease that involves chronic inflammation — everything from cancer and Alzheimer's to heart disease and arthritis.

The research, lead by the laboratories of Niren Murthy at the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University and Dr. Robert Taylor in the Division of Cardiology at the Emory University School of Medicine, will appear in the October issue of *Nature Materials* and was funded by the National Science Foundation and the National Institutes of Health.

Hydrogen peroxide is thought to be over-produced by cells at the early stages of most diseases. Because there were previously no imaging techniques available to capture this process in the body, the details of how the hydrogen peroxide is produced and its role in a developing disease must still be determined.

The Georgia Tech and Emory nanoparticles may be the key to better understanding the role of hydrogen peroxide in the progression of many diseases and later play an important diagnostic role, Murthy said.

"These nanoparticles are incredibly sensitive so you can detect nanomolar concentrations of hydrogen peroxide. That's important because researchers aren't yet certain what amounts of hydrogen peroxide are present in various diseases," Murthy said.

The ultimate goal, however, is that the nanoparticles could some day be used as a simple, all-purpose diagnostic tool for most diseases. In the future, the nanoparticle would be injected by needle into a certain area of the body (for instance, the heart). If the nanoparticles encountered hydrogen peroxide, they would emit light. Should a doctor see a significant amount of light activity in the area, the doctor would know that the patient may be presenting early signs of a disease in that area of the body.

The Georgia Tech and Emory nanoparticles penetrate deep tissue and operate at a high wave length, making them sensitive indicators of the presence of hydrogen peroxide produced by any sort of inflammation.

The nanoparticle polymer is made of peroxalate esters. A fluorescent dye (pentacene) is then encapsulated

into the polymer. When the nano particles bump into hydrogen peroxide, they excite the dye, which then emits photons (or light) that can be detected in a simple, photon-counting scan.

“It’s using this nanoparticle made of peroxalate esters that allows you to do this three component reaction in vivo. If you were to inject a peroxalate ester and a dye, they would go their own ways once in the body. With the nanoparticles we can sequester both of these reagents within nanometers of each other, in vivo,” Murthy said.

The goal was to maximize the wavelength of the particles. Wavelength determines the sensitivity in vivo. And if the particle’s wavelength is high enough, it can penetrate the skin and display clearly on a scan.

The research team started with a nanoparticle that was made of dye and filled with peroxide esthers. They later realized that the reverse (a particle made of peroxalate esters and filled with dye) was more effective at imaging hydrogen peroxide, Murthy said.

The group will conduct further tests with the nanoparticles to confirm their safety and effectiveness.

Source: Georgia Institute of Technology