

Detecting Cancer with Silica Nanoparticles

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Tumor necrosis factor-alpha is a widely accepted biomarker for cancer, but the minute amounts of this protein circulating in blood makes detecting the molecule and measuring its concentration accurately a technological challenge.

Using silica nanoparticles labeled with the molecule guanine, researchers at the Pacific Northwest National Laboratory have now created a simple and inexpensive electrochemical method that detects tumor necrosis factor-alpha (TNF- α) at clinically useful levels. Moreover, this assay is amenable to miniaturization, suggesting that it could be easily incorporated into a microfluidics-based assay system.

Reporting its work in the journal *Analytical Chemistry*, a research team headed by Yuehe Lin, Ph.D., loaded guanine molecules onto the surface of silica nanobeads that also contained a chemical anchor known as avidin. They also attached biotin, which binds with extraordinary strength to avidin, to an antibody that binds to the TNF- α protein. The researchers attached a second antibody, one that binds to a different part of the TNF- α protein, to a carbon electrode, which functions as the electrochemical sensor.

When TNF- α is present in a solution added to the antibody-labeled electrode, it binds to the antibody. Adding the second antibody produces a sandwich around the TNF- α molecule. At this point, the researchers then added their labeled silica nanoparticle, which binds to the antibody-TNF- α sandwich. In a final step, the investigators added a molecule that reacts with the guanines on the nanoparticle, creating an electrical

current that the electrode senses. The current flowing into the electrode is proportional to the amount of TNF- α bound to the first antibody. Experiments with this system showed that the limit of detection for the device is approximately 2 picomolar, well within the range needed to detect physiological levels of TNF- α .

This work is detailed in a paper titled, “Sensitive immunoassay of a biomarker tumor necrosis factor- α based on poly(guanine)-functionalized silica nanoparticle label.” This paper was published online in advance of print publication. An abstract of this paper is available at the [journal’s website](#).

Source: National Cancer Institute

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