Fast Protease Assay Using Nanoengineered Photonic Crystals

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Proteases are a family of enzymes that play a central role in cellular metabolism and are key players in many diseases, including cancer. Conventional assays for protease activity are often slow – most take up to 24 hours to generate results – and require relatively large samples – in the 100 to 500 microliter size – to achieve sensitivity capable of detecting low picomole amounts of protease. These characteristics hinder both basic research and drug development efforts.

To overcome these limitations, a team of investigators at the Center of Nanotechnology for Treatment, Understanding, and Monitoring of Cancer (NANO-TUMOR), a National Cancer Institute-funded Center for Cancer Nanotechnology Excellence based at the University of California, San Diego, turned to nanoengineered porous-silicon photonic crystals to create a far faster and more sensitive protease assay system.

This new system, created by Michael Sailor, Ph.D., and his colleagues, is compatible with high-throughput array technologies. The researchers report their work on this system in the journal *Advanced Materials*.

To create their protease assay device, the investigators first create a photonic silicon crystal that refracts light at a specific wavelength and gives the crystal a distinct color. They then layer a thin coating of a protein onto the silicon crystal, which changes the observed color of the crystal to a greenish color. This thin protein coat also acts as a substrate for proteases, which digest protein. When digestion occurs, the color of the chip changes. This change, from green to orange-red, is visible with

the naked eye.

Tests with this system showed that a visible color change occurred within an hour of placing a 1 microliter drop of protease solution on the surface of the protein-coated chip. This color change could be seen with as little as 7.2 picomoles of protease. The investigators note that coating the nanoengineered silicon photonic crystals with molecules other than proteins could produce quick, sensitive assay devices for other important classes of enzymes, such as those that digest DNA or RNA.

This work, which was funded in part by the National Cancer Institute's Alliance for Nanotechnology in Cancer, is detailed in a paper titled, "Protein-coated porous-silicon photonic crystals for amplified optical detection of protease activity." An investigator from the University of Auckland, New Zealand, also participated in this study. An abstract of this paper is available at the journal's website.

Source: National Cancer Institute