Quantum Rods and Dots Image Cancer Cells

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Brightly fluorescent quantum dots and quantum rods are quickly becoming important tools for identifying specific molecules and cells in living systems. Two new reports demonstrate some of the ways in which cancer researchers are using these nanoscale imaging agents.

Hideo Higuchi, Ph.D., and colleagues at Tohoku University in Japan, used antibody-labeled quantum dots and a high-sensitivity fluorescence microscope fitted with a video camera to make 30-frame-per-second movies of these nanoparticles as they traveled through the bloodstream to tumors in mice. In a paper published in the journal *Cancer Research*, the investigators identified six distinct steps in the process by which quantum dots labeled with the HER2 monoclonal antibody travel from the site of injection to the space surrounding the cell nucleus. The HER2 monoclonal antibody binds to a protein found on the surface of certain breast and other tumors.

Using the labeled quantum dots, the researchers obtained quantative measurements of these six steps. From these experiments, the investigators were able to determine that each stage of the delivery process proceeds in a stop-and-go manner. The researchers note that a better understanding of each of these steps could improve the ability of nanoparticles to deliver drugs specifically to tumors.

In another study, Paras Prasad, Ph.D., and his colleagues at the State University of New York in Buffalo showed that they could create water-soluble quantum rods that can be used as targeted probes for imaging cancer cells using a technique known as two-photon fluorescence

imaging. Quantum rods, like spherical quantum dots, can be made to fluoresce with a wide range of colors, but the larger dimensions of quantum rods make them easier to excite with incoming light than their spherical cousins. This work, conducted as part of the Multifunctional Nanoparticles in Diagnosis and Therapy of Pancreatic Cancer Platform Partnership, was published in the journal *Nano Letters*.

Prasad and his collaborators first developed a new method for making quantum rods that would remain well-dispersed in water, and then refined their synthetic technique to also include the ability to attach targeting molecules to the surface of the quantum rods. In the reported experiments, the investigators attached a protein known as transferrin to the quantum rods. Transferrin binds to a receptor that is overexpressed on many types of cancer cells.

Experiments with these labeled quantum rods showed that they were only taken up by targeted cells, and that they accumulated within the targeted cells. The quantum rods were readily visible within the cells using low-intensity near-infrared light. The ability to use low-intensity light to detect the quantum rods helps protect the integrity of the targeted cells.

The work with quantum dots is detailed in a paper titled, “In vivo real-time tracking of single quantum dots conjugated with monoclonal anti-HER2 antibody in tumors of mice.” An abstract of this paper is available through PubMed.

The work with quantum rods, which was supported by the National Cancer Institute’s Alliance for Nanotechnology in Cancer, is detailed in a paper titled, “Quantum rod bioconjugates as targeted probes for confocal and two-photon fluorescence imaging of cancer cells.” This paper was published online in advance of print publication. An abstract of this paper is available through PubMed.

Source: National Cancer Institute