Fluorescent organic nanoparticles help illuminate cellular proteins

Like a smart highlighter, immunofluorescent labeling can zero in on a specific protein, helping scientists understand the structure of a cell and how diseases affect that structure. Current techniques have disadvantages, though.

University of Michigan scientists developed a non-toxic, organic nanoparticle for immunofluorescent labeling that makes a bright, longer-lasting glow without the drawbacks of today's popular methods. A paper on the research will be published in the March 18 edition of the journal *Advanced Materials*.

"We've demonstrated the promising application of organic nanoparticles for immunofluorescent labeling," said Jinsang Kim, assistant professor of materials science and engineering who is the principal investigator of this research.

"Our molecules show unique properties. When they clump together, they get brighter, which is the opposite of what normally happens. Normally, when fluorescent molecules clump together, they become much dimmer, which is called self-quenching. Self-quenching is not a problem for our molecules."

Immunofluorescent labeling works like this: Scientists join fluorescent particles with protein-seeking molecules and let the companions loose in cells to bind to the protein they want to locate and study. The scientists then radiate the mixture with ultraviolet light. The light causes the fluorescent particles to glow, giving away the location of the protein the scientists were looking for.

Certain diseases can change the amount of particular proteins in cells. Prostate tumors, for example, can increase the level of prostate-specific antigen, or PSA, which is a cellular protein.

For fluorescent particles, scientists can currently choose between organic fluorescent dyes and inorganic quantum dots, both of which have shortcomings. Organic fluorescent dyes wear out easily from the ultraviolet light and inorganic quantum dots are toxic.

Kim's nanoparticles bridge the gap between these methods. They're non-toxic, and the researchers' novel way of making the nanoparticles causes them to shine brightly without deteriorating as easily as organic dyes.

Kim and his colleagues started by directing the self-assembly of a new kind of green fluorescent organic molecule called DBO. They mixed the fluorescent organic molecules in water together with a molecule called diacetylene that formed multi-layered bubbles around the fluorescent molecules and formed polymers. The fluorescent molecules glowed more than 12 times brighter in the multi-layered bubbles than they did in plain solution because of a unique arrangement of the molecules inside the bubbles.

The researchers tested their new nanoparticles by attaching them to biotin, a molecule that binds readily with the protein avidin. The researchers released the nanoparticles with biotin on a glass slide containing spots of avidin. The biotin found the avidin and Kim's nanoparticles glowed.

"More interestingly," Kim said, "the pressure-sensitive polydiacetylene bilayer surrounding the fluorescent nanoparticles also produced its own red fluorescence induced by the pressure the nanoparticles experienced when they attached to the target area. Green can't be seen through skin, but red can. This suggests additional applications for these nanoparticles."

The paper is called "Highly Emissive Self-assembled Organic Nanoparticles having Dual Color Capacity

for Targeted Immunofluorescent Labeling."

Source: University of Michigan