Scientists shed light on molecules in living cells

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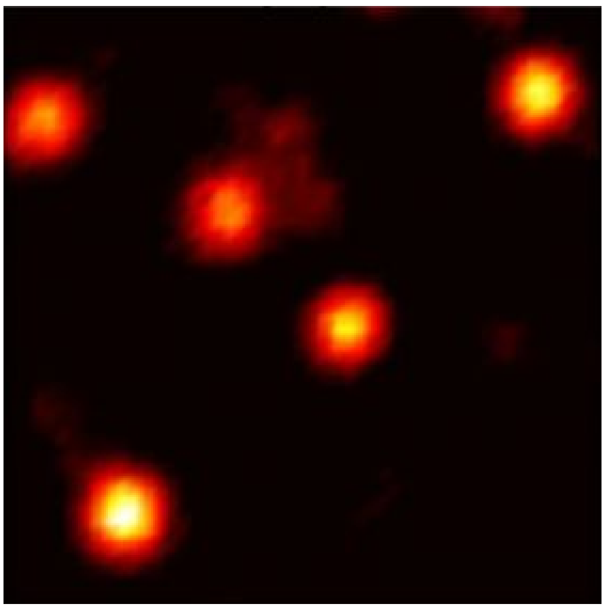

Microscope image of individual fluorescent "polymer dot" nanoparticles spread out on a glass slide. Credit: Jason McNeill, Clemson University

Clemson University chemists have developed a method to dramatically improve the longevity of fluorescent nanoparticles that may someday help researchers track the motion of a single molecule as it travels through a living cell.

The chemists are exploiting a process called “resonance energy transfer,” which occurs when fluorescent dye molecules are added to the nanoparticles. Their findings will be reported at the 234th annual national American Chemical Society meeting Aug.19-24 in Boston.

If scientists could track the motion of a single molecule within a living cell it could reveal a world of information. Among other things, scientists could determine how viruses invade a cell or how proteins operate in the body. Such technology also could help doctors pinpoint the exact location of cancer cells in order to better focus treatment and minimize damage to healthy tissue. Outside the body, the technology could help speed up detection of such toxins as anthrax.

The key to developing single-molecule tracking technology may be the development of better fluorescent nanoparticles.

Fluorescent nanoparticles are thousands of times smaller than the width of a human hair and are similar in size to protein molecules, to which they can be attached. When illuminated by a laser beam inside a light microscope equipped with a sensitive digital camera, the nanoparticle attached to a protein will light up, allowing scientists to get a precise fix on the position of the protein and monitor its motion inside a cell.

Until now, nanoparticles have been too dim to detect inside cells, but Clemson chemists have developed a novel type of nanoparticles containing materials called conjugated polymers that light up and stay lit long enough for scientists to string together thousands of images, as in a movie.

Conjugated polymers share many properties with semiconductors like silicon but have the flexibility of plastic. While initial efforts at preparing nanoparticles out of conjugated polymers resulted in particles that were very bright, their brightness quickly faded under the bright glare of a laser beam.

“When a conjugated polymer is in a high energy state, it is vulnerable to attack by oxygen," says principal investigator and chemist Jason McNeill. "The dye efficiently removes the energy from the molecule and re-emits the energy as light, which greatly improves the brightness and longevity of the nanoparticles."

McNeill says other possible targets of investigation include the formation of plaques and fibrils in the brain associated with Alzheimer's disease and mad cow disease. Graduate students Changfeng Wu, Craig Szymanski, Jennifer Grimland and Yueli Zheng contributed to the study, which the National Science Foundation funded.

Clemson University chemists are presenting 40 papers on a wide range of subjects at the society meeting. Other topics include detection and quantification of uranium in groundwater, conversion of lipid feedstocks such as poultry fat to biodiesel and a new mechanism for antioxidants that fight DNA damage.

Source: Clemson University