Quantum Dots Research Leads to New Knowledge about Protein Binding in Plants

January 26 2005

UC Riverside researchers from the Departments of Chemical and Environmental Engineering, Mechanical Engineering and Botany and Plant Sciences have worked together to discover a way to utilize Quantum Dot bio-conjugates to uncover new knowledge about the binding of a protein at the growing pollen tube tip. This protein plays a critical role along with another protein (chemocyanin) in guiding sperm-laden pollen tubes to the eggs found in ovules.

Applying nanoparticles for imaging the protein localization revealed information that could not be observed previously by conventional imaging techniques. This study provides a new tool to botanical scientists by merging areas of materials science, chemistry and plant biology.

The findings are the result of an interdisciplinary research team including Sathyajith Ravindran of the Chemical and Environmental Engineering Department; Sunran Kim, Rebecca Martin and Elizabeth M. Lord of the Botany and Plant Sciences Department; and Cengiz S. Ozkan of the Mechanical Engineering Department at UC-Riverside.

The results of their collaborative research appeared in an article titled "Quantum Dots as Bio-labels for the Localization of a Small Plant Adhesion Protein" and published in the January 2005 issue of Nanotechnology, and is a featured article at nanotechweb.org. Journal Nanotechnology has an international readership among academic, government and corporate sectors, and is dedicated to coverage of all aspects of nanoscale science and technology from a multidisciplinary

perspective.

Ozkan and his colleagues utilized cadmium selenide (CdSe) quantum dots coated with zinc sulphide as fluorescent probes. The particles had a diameter of 6.3 nm. The team terminated the quantum dots with carboxylic groups by reacting them with mercaptoacetic acid. Then they conjugated the quantum dots with the amine groups of stigma/stylar cysteine-rich adhesin (SCA) - a plant pollen tube adhesion protein. This labeled the protein molecules with fluorescent tags.

Quantum dots are much more resistant to photobleaching than conventional fluorescent markers and their small size make them ideal for biological imaging. The researchers then added the molecules to germinated lily pollen grains and examined them under a confocal microscope.

This is the very first time that Quantum Dots have been utilized for live imaging in plant systems. The study opens the door for the potential use of Quantum Dots in live imaging of plant cells and provides valuable understanding of the mechanism of interaction between the pollen tube and female tissue during reproduction.

“Integrating materials science, chemistry and plant biology to understand how and where specific proteins act on a pollen tube is one more step towards a better understanding of the fundamental processes involved, namely the network of the signaling process in plant reproduction,” said Ozkan. "A better understanding of the interaction of SCA with pollen tubes could help with successful plant breeding”.

Source: University of California, Riverside