BIOEN 509 – DEPARTMENTAL SEMINAR SERIES

Thursday, Feb. 16th 2012, 12:30-1:20 PM
Foege Bioengineering Building N130A

Nano-neuroscience, from engineering to application and back to engineering

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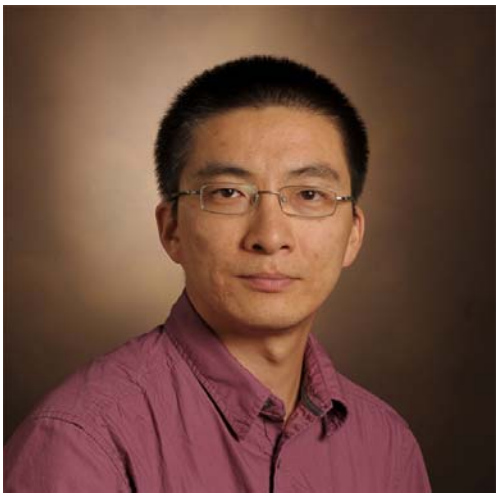
Our brain is the most complicated network made of billions of neurons and trillions of connections known as synapses. To pack such an astronomic number of cells in the skull, most cellular structures are extremely tiny. For example, a typical synapse composing presynaptic and postsynaptic terminals from connected neurons in the central nerve system is only about 1 □m in diameter. This put a big challenge for labeling and measuring cellular events happened in those miniscule structures. Small size limits the amount of markers one can put in and scarce label increases difficulty in detection. Generally, progresses on two frontiers have been made to overcome this hurdle, more powerful probes and more sensitive assessment. Immediately after the development of water-soluble photo-luminescent nanoparticles (a.k.a. quantum dot, Qdots), neuroscientists started to apply it for high-resolution imaging. Quickly followed is an explosion of papers on the techniques and discovers based on the advantageous properties of theses nanoparticles. Focusing on the structure and functionality of various synaptic apparatus, we have begun to employ functionalized Qdots in our research projects. In addition to their superior photo-properties, we found that the size and the surface versatility of Qdots provide unlimited potential in solving many thorny problems in the field of neurophysiology. To fully utilize their exceptional features, we are innovating new classes of Qdot conjugates and new types of optical imaging methods tailed to Qdots. Examples that will be presented include the application of Qdots in studying synaptic vesicles, novel Qdot conjugates in investigating protein and vesicle trafficking, and 3D super-resolution tracking of single Qdots.



Dr. Zhang is an assistant professor in the Department of Pharmacology, a member of the Vanderbilt Institute of Nanoscale Science and Engineering and Vanderbilt Kennedy Center. He is the recipient of Grass Fellowship in Marine Biology Laboratory, AFAR/Gilbert Foundation New Investigator Award, NARSAD Young Investigator Award, NIH Pathway to Independence Award (K99/R00), and NIH New Innovator Award (DP2). Past research topics included the development of bioinformatic programs for cloning disease-related human genes and molecular and physiological manipulation of exocytosis in astroglia. Qi's current research interests focus on the physiology of synaptic transmission and the plasticity of neuronal network. He has published first-author papers in high-profile journals including JBC, PNAS and Science. His work is supported by federal and private grants from various basic and clinic oriented organizations.

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