PHYSIOLOGY & MEMBRANE BIOLOGY

SCHOOL OF MEDICINE

UNIVERSITY OF CALIFORNIA AT DAVIS

DISTINGUISHED SPEAKER SERIES

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"Next-generation nanocrystals for cellular imaging"

Nanocrystals that have unusual or exceptional optical properties have shown promise as transformative probes for biological imaging. Phosphorescent upconverting nanoparticles (UCNPs) have proven to be especially promising as biological labels and single-particle studies of UCNPs have shown that they exhibit nearly ideal properties as single molecule imaging probes. UCNPs absorb two or more photons in the near infrared and emit one at shorter wavelengths in the visible or nIR, an unusual characteristic that distinguishes them from all luminescent chemicals in the cell, and one that suggests background-free cellular imaging. We have shown that UCNPs do not blink on and off as most other probes do, and that they possess remarkable photostability, resisting photobleaching under continuous irradiation long after organic dyes, proteins, and even quantum dots are extinguished. We have recently developed synthetic methods for control of UCNP size, and completed a combinatorial lanthanide scan in order to tune emission wavelengths for multicolor upconverted imaging. We have also developed methods for studying single nanocrystal lifetimes and emission spectra, which has allowed us to understand Lanthanide-lanthanide communication within the nanocrystal.

We have also developed luminescent nanocrystal-based thermometers able to detect sub- °C variations within live cells. Temperature is a key parameter in all physiological processes, and probes able to detect small changes in local temperature are necessary for accurate physical descriptions of cellular events. We have conjugated aqueous CdSe-CdS quantum dot-quantum rods conjugated to far-red cyanine dyes, and these probes exhibit a ratiometric 2.4% change per °C over physiological temperatures in aqueous buffers, with a precision of at least 0.2 °C. Within cells, these nanothermometers showed an unexpected enhancement in their temperature response and sensitivity, highlighting the need to calibrate novel probes within the cell.

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Genome and Biomedical Sciences Facility

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