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IAPME Seminar

Nanocomposite Materials with Enhanced Two-photon Optical Properties for Biomedical Applications

25 August 2025

Prof. Qing-Hua XU
Eastern Institute of Technology

Venue: N23-3022
Time: 10:00 - 11:00
Hosted by: Prof. Guichuan XING

Abstract

Two-photon excitation techniques have unique advantages such as 3-dimensional selectivity and deep penetration into biological tissues in biomedical applications compared to their one-photon counterparts. Here I would like to present our group's efforts on development of various nanomaterials with enhanced two-photon properties for biomedical applications by using two different strategies. One is based on fluorescence resonance energy transfer from conjugated polymers that have large two-photon absorption cross sections as two-photon light harvesting materials. We have developed various schemes for two-photon sensing, imaging, and photodynamic therapy, with efficiency improved by ~1000-fold. Another approach is based on plasmon resonance enhancement. The unique localized surface plasmon resonance properties of noble metal nanoparticles are known capable of enhancing optical properties of external chromophores and metal nanoparticles themselves. We have developed various plasmon engineered hybrid nanomaterials with enhanced two-photon properties, explored their biological applications, and conducted single particle and ultrafast spectroscopic studies to understand the underlying enhancement mechanisms. We have further combined these two strategies to develop plasmon enhanced two-photon optical properties of conjugated polymer-based NPs for biomedical applications.

Biography

Prof. Qing-Hua XU received his B.S. from Zhejiang University in 1993, M.S. from Peking University (1996) and University of Chicago in 1997, and Ph.D. from UC Berkeley in 2001. He conducted the postdoctoral research at Stanford University from 2001 to 2002 and UC Santa Barbara from 2002 to 2005. He joined NUS Chemistry in 2005 and became a tenured Associate Professor in 2011. He joined Eastern Institute Technology, as a founding professor in 2024. His primary research interests focus on optical responses and dynamical processes of novel low-dimensional materials as well as their applications in biomedicine, optoelectronics, energy, and environmental areas. So far, he has published ~260 peer-reviewed articles with total citations of >21,000 times and H-index of 84 (Google scholar).