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Engineering upconverting nanophosphors as biosensors and biotherapeutic agents

SHUANG FANG LIM, North Carolina State University

Contrast agents play an important role in the study of biological tissues and whole organisms, since they enable visualization of functional structures. Fluorescent contrast agents also enable specific targeting in therapeutic approaches. Developing optimized contrast agents is central to optimizing the performance of both imaging and therapy. Upconversion nanophosphors (UCNPs) are a class of nanoparticles which enable efficient 2-photon fluorescence. Their intrinsic properties of low toxicity, low excitation intensity, narrow fluorescence line width, multiplexing capability, zero fluorescent background, and absence of bleaching and blinking make them strong candidates as a contrast agent with wide applicability. I am working to develop these nanomaterials with biological significance as contrast agents in biolabels, in biosensors and as therapeutic agents in photodynamic therapy. This will be combined with the enhancement of brightness of the UCNPs through coupling to resonant gold nanostructures. The study is necessary in order to bring about a break through in upconversion luminescence enhancement, particularly at ever decreasing nanoparticle sizes necessary for biological applications.