From Molecule to Mammal: Inventing Luminescent Nanoparticles for Biology

Gang Han, Ph.D.
Professor
Biochemistry and Molecular Pharmacology Department
University of Massachusetts- Medical School
364 Plantation Street, LRB 806, Worcester, MA USA
Email: gang.han@umassmed.edu

Abstract
Functional luminescent nanoparticles are promising materials for in vitro and in vivo optical imaging and therapy due to their unique optical and chemical properties. In this talk, I will present a series of biocompatible luminescence nanoparticles. The first type of materials is upconversion nanoparticles (UCNPs). I will present new developments regarding engineering UCNPs towards optogenetic applications in immunotherapy as well as the most recent application in regard to create mammalian infrared imaging vision. The second type of nanoparticles is persistent luminescence nanoparticles (PLNPs). They are bioluminescence-like and possess unprecedented in vivo deep tissue energy rechargeability, outstanding signal-to-noise-ratio with no need for an excitation resource (light) during imaging, and they can be directly detected with existing imaging systems. These nanoparticles continue to emit light for minutes or hours and, in some cases, days, after turning off the excitation source. These long-lasting, light-emitting nanocrystals can provide noninvasive imaging technology for evaluating structural and functional biological processes in living animals and patients. The third is a type of organic Biodpy nanoparticles that were tailored with outstanding NIR absorbing ability. Rather than the conventional laser light needed in PDT, I will present their ultralow power lamp operable PDT applications in deep tissue tumor treatment. Finally, I would like also to introduce a new organic upconversion system for in vivo anticancer release.

Biography
Dr. Gang Han is currently a Professor in the Biochemistry and Molecular Pharmacology Department at University of Massachusetts- Medical School. He received his B.Sc. and M.S. degrees in Chemistry from Nanjing University, and his Ph.D. degree in Chemistry from University of Massachusetts-Amherst. He was a postdoctoral scholar at the Molecular Foundry, Lawrence Berkeley National Lab. Dr. Han has published over 100 papers in Journals such as Cell, Nature, Nature Nanotechnology, Nature Communications , Elife, PNAS, JACS, Angewandte Chemie, Advanced Materials, Nano letters, ACS Nano, which have cited over 11000 times, h-index 43. He was honored awards such as NIH Exceptional Unconventional Research Enabling Knowledge Acceleration (EUREKA) Award, NIH/NCI Innovative Research in Cancer Nanotechnology (IRCN) Award and Human Frontier Science Program Young Investigator Award, Worcester Foundation Mel Cutler Award. His current research focuses on the development of biocompatible functional luminescent nanoparticles and molecules for optical imaging, sensing and light controlled immune-engineering and neuron activation.
Professor Han's profile page: https://www.umassmed.edu/hanlab/

Research Highlights by NIH:
https://directorsblog.nih.gov/2019/03/05/nanoantennae-make-infrared-vision-possible/