Colloquium

Department of Physics, Temple University

Nanophotonic Structures for Solar Light Harvesting and Ultrafast Optical Responses

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Abstract

Future nanophotonic architectures for optical energy conversion and photocatalysis will require nanostructures with roles that work together cooperatively, such as structures with a large absorption cross section combined with features that enable guiding, propagating, and converting energy. Ultrafast optical responses in nanostructures are critical to understand for these applications. Although there is the potential for radiative and nonradiative energy losses, there is also the opportunity for accessing pathways for improved energy conversion, such as through the extraction of hot plasmonic electrons from metal nanoparticles. For propagation of energy in nanophotonic structures, nanostructured materials inspired by natural photosynthetic membranes represent an opportunity for efficient and directional energy transport. In natural photosystems, light harvesting complexes can transport excitons to the reaction center core with near unity conversion of absorbed photons to separated charge. A key to this process is the high rate of exciton hopping and the directionality of exciton flow due to an energy level waterfall effect of excitons in complexes as the reaction center core is approached. Efforts to induce similar behavior in biomimetically inspired nanostructures are described. Finally efforts to image exciton flow in nanoscale materials are described. Use of the Center for Nanoscale Materials was supported by the U. S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under Contract No. DE-AC02-06CH11357.

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SERC, Room 110B
Refreshments served at 2:45pm