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Special Guest Lectures

Nanoscale theory and simulation: light interactions with metallic nanosystems

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Abstract:
Material processing techniques can now engineer materials with nanoscale features. When light interacts with such nanosystems, complex electromagnetic wave phenomena can emerge through strong near field interactions. For example, surface plasmons (SP's), collective resonances of free electrons in a metal, can be excited in metallic nanosystems. SP's yield intriguing near field phenomena such as highly localized fields and strong intensities. With strong, yet complex, near field interactions, such systems provide ways of controlling light at the subwavelength scale. First-principles computational modeling tools provide invaluable insights about the complex wave phenomena inherent in light interactions in metallic nanosystems. They also can be used to conduct inexpensive feasibility studies of novel device ideas and allow one to optimize device designs prior to fabrication. First, we address usefulness of numerical approaches in nanophotonic research. Next, three new types of nanosystem are proposed and explored numerically. System 1: A cone shaped silver nanoparticle interacting with chirped optical pulses. Rigorous numerical simulations reveal how spatio-temporal control of an SP local hot spot can be achieved. The simulations also demonstrate counterintuitive negative group velocity in some situations. System 2: A way to increase surface plasmon polariton (SPP) propagation length and intensity is proposed. (An SPP is a propagating SP excitation.) The underlying mechanism involves reflecting back radiation losses to propagating metal surface region, regenerating SPP's. Extensive finite-difference time-domain simulations, including coupling of external light into the system, demonstrate significant improvements. System 3: Re-directing light propagation with a sharp angle turn is a decades long problem in photonic integrated circuit research. In this study, we discuss light propagating and bending in a slit waveguide. The discussion is based on accurate numerical solutions of Maxwell

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Speaker's Bio:
Tae Woo Lee received his Ph.D. in Electrical Engineering from the University of Wisconsin-Madison. He has a M.S. Electrical Engineering from the University of Wisconsin-Madison, a M.S. Physics from Inha University (Inchon, South Korea), and a B.S. Physics from Inha University (Inchon, South Korea). Tae Woo Lee is currently a Post Doctoral Fellow in the Nanophotonics, Chemistry Division & Center for Nanoscale Material Science at the Argonne National Laboratory.