

Department of Electrical and Computer Engineering

Center for Integrated Bio and Nano Systems

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11:15 a.m. (Refreshments served at 12:15 pm)

Room: CBB 104

Absorption and ultrafast microscopies on single plasmonic nanostructures

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Abstract: Plasmonic nanostructures have attracted significant attention because of their unique optical properties arising from localized surface plasmon resonances (LSPR). Due to the high optical sensitivity of LSPR to size, shape, electron density, and local environments, it is possible to probe the physical and chemical processes on nanoparticles by monitoring their spectral change of LSPR. However, the inhomogeneous broadening caused by the size and shape heterogeneities in chemically synthesized nanoparticles impedes the detailed spectroscopic information in conventional ensemble measurements. In addition, optical characterization is usually performed using scattering methods, or extinction, which is the sum of absorption and scattering. Separate measurements of the absorption and scattering are important as absorption determines nanoparticle heating and hot electron generation, while scattering represents the strength of nanoparticle antenna. Single-nanoparticle spectroscopy resolves the obstacles of sample heterogeneity, and the ultrafast capability provides additional energy relaxation dynamics after plasmon decays.

In this talk, I will present a new technique to separately measure steady-state absorption and scattering spectra on single gold nanospheres, nanorods and particle clusters. A comparison of the absorption spectra to the scattering spectra of the same individual gold nanoparticles reveals a small blueshift of the absorption spectra. This shift originates from the different plasmon energy between near-field and far-field responses, and the amplitude of the shift is determined by the total damping of the plasmon. In contrast, the absorption deviates significantly from the scattering for the nanoparticle clusters due to interference of bright and dark modes giving rise to a Fano resonance. I will also discuss ultrafast dynamics of gold and aluminum nanodisks fabricated by lithographic method. We observed that the acoustic properties of gold nanodisk can be tuned by the thickness of titanium adhesion layer arising from the binding strength of the nanostructures to the glass substrate. For aluminum nanodisks, we found a moderate binding to the glass substrate affected by the native aluminum oxide layer.

Bio: Wei-Shun Chang is currently a research fellow in the Department of Chemistry at Rice University. He received Ph. D. from UT Austin in 2007 supervised by Prof. Paul Barbara. He joined Link group at Rice University in 2007 as a postdoctoral researcher and became a research fellow since 2012. His research interest is to study optical properties of plasmonic nanomaterials using single-particle spectroscopy. He has developed steady-state and time-resolved spectroscopic techniques to investigate collective optical properties of plasmonic nanoparticles, plasmon-mediated chemistry, chiral

plasmonics, and plasmon optomechanics. He also co-authored on 55 peer-reviewed papers and served as a reviewer for 21 journals.
Contact Prof. Jiming Bao (jbao@uh.edu) if you would like to arrange for a time to meet with Dr. Chang.