UCMERCED | CHEMISTRY & BIOCHEMISTRY

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CHEMISTRY & BIOCHEMISTRY SEMINAR SERIES:

Nanometer-Scale Spatial and Spectral Mapping of Exciton Polaritons in Structured Plasmonic Cavities

Abstract:

Exciton polaritons (EPs) are ubiquitous light-matter excitations under intense investigation as test beds of fundamental physics and as components for all-optical computing. Owing to their unique attributes and facile experimental tunability, EPs potentially enable strong nonlinearities, condensation, and superfluidity at room temperature. However, the diffraction limit of light and broad momentum content of fast electron probes preclude the characterization of EPs in nanoscale structured cavities exhibiting energy-momentum dispersion. Through an innovative combination of electron beam and optical probes, I will show theoretically that these limitations can be overcome to measure EPs in periodic nanophotonic cavities at their natural energy, momentum, and length scales via lattice electron energy gain spectroscopy. With the combined high momentum resolution of light and nanoscale spatial resolution of free-space focused electron beams, lattice electron energy gain spectroscopy can expose deeply subwavelength EP features using currently available monochromated, aberration-corrected scanning transmission electron microscopes (STEMs). Time permitting, I will also discuss the addition of polarization structure to the STEM electron probe and demonstrate theoretically how this degree of freedom can be harnessed to characterize the 3D polarization-resolved response field and local chirality of an optically excited target with nanoscale spatial resolution.

David J. Masiello
Professor of Chemistry
University of Washington

About the Speaker:

Originally from New England, David J. Masiello went to college and graduate school at the University of Florida where he earned a B.S. degree in Mathematics in 1999 and a Ph.D. in Chemical Physics in 2004 under the advisement of Professor Yngve Öhrn at the Quantum Theory Project (QTP). As an undergraduate, David conducted research in nonlinear optics at the University of Bordeaux's Centre de Physique Moléculaire Optique et Hertzienne (CPMOH) and in photothermal refractive glasses at the University of Central Florida's Center for Research and Education in Optics and Lasers (CREOL). At the QTP, David's dissertation work explored a nonperturbative treatment of the interaction between molecules and the electromagnetic field, accounting for the redistribution of energy not only between different internal molecular degrees of freedom but also for its liberation to the dynamical electromagnetic field. He then took two postdoctoral positions, one with Professor William P. Reinhardt at the University of Washington (2004-2006) and the second with Professor George C. Schatz at Northwestern University (2006-2009). Subsequently, David was hired back to the University of Washington in 2010 as an assistant professor in theoretical chemistry. In 2016 he was promoted to associate professor with tenure and in 2019 he was promoted to full professor and Bernard and Claudine Nist Endowed Scholar in Chemistry. Currently, Professor Masiello's research focuses on the theoretical understanding of nanoscale light-matter interactions in nanophotonics, plasmonics, and quantum optics probed using advanced electron beam and optical spectromicroscopies. Particular emphasis is placed upon bringing insight and understanding to experiment through the formulation of simple yet rich theoretical models. David is also an adjunct professor of Applied Mathematics and Materials Science and Engineering at UW. David is a recipient of an NSF CAREER Award in 2013 and a Presidential Early Career Award (PECASE) awarded by President Obama in 2016.

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