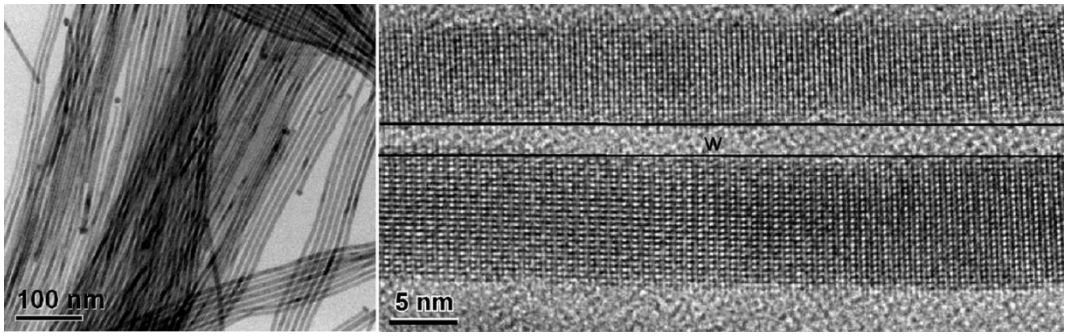
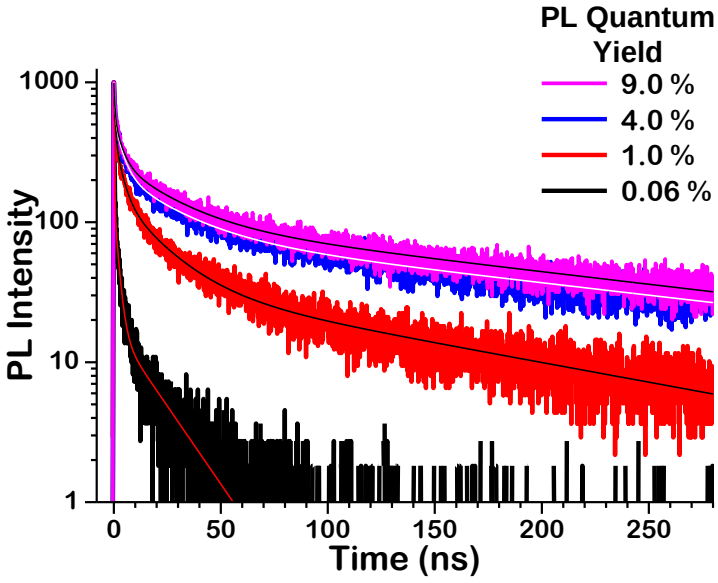
"Dynamics in Semiconductor Quantum Wires"

Richard A. Loomis, *Department of Chemistry and Institute of Materials Science & Engineering, Washington University in St. Louis*

We are investigating the dynamics of charge carriers in one-dimensional (1D) semiconductor quantum wires (QWs), nanoparticles with small radii and lengths that span microns. While the nature of electron-hole pairs photogenerated within semiconductor QWs should resemble quantum mechanical particles in a cylinder, the basics of these systems are not fully understood.



We are using a number of *cw* and time-resolved microscopy techniques to characterize the energetics and dynamics of electron-hole pairs in CdSe and CdTe/CdS QWs. Specifically, we are investigating: a) the energetics of the electrons and holes that are perturbed by the small radial dimensions of the QWs; b) the electron-hole interactions that result from Coulombic forces and self-imaging effects; and c) the free-wave nature of bound electron-hole pairs, or 1D excitons, along the lengths of the QWs. Interestingly, as 1D excitons diffuse along a QW the electron-hole pairs cannot recombine radiatively due to conservation of momentum constraints. As a result, we observe the delocalization of 1D excitons along the entire lengths of CdSe QWs, longer than 10 μm. In addition, the photoluminescence lifetimes are observed to be exceptionally long, an order of magnitude longer than the estimated radiative lifetime.



Prof. Richard A. Loomis

Department of Chemistry and the Institute of Materials Science & Engineering
Washington University in St. Louis
(www.chemistry.wustl.edu/faculty/loomis)

Biography

Professor Richard A. Loomis received his B.S. (1989) with latin honors from Dickinson College. He received his Ph.D. (1995) under the guidance of Professor Marsha I. Lester in the Department of Chemistry at the University of Pennsylvania. He received a prestigious NRC postdoctoral fellowship, and worked with Stephen R. Leone at JILA, a joint institute between the University of Colorado and NIST. He joined Washington University as an Assistant Professor in 1998, was promoted to Associate Professor in 2005, and earned Full Professor in 2017. He has served as the Director of Graduate Studies in Chemistry since 2000, and holds a position in the Institute for Materials Science & Engineering at Washington University.

Professor Loomis has received numerous awards, including a David and Lucile Packard Fellowship in Science and Engineering, an NSF-CAREER award, a Fellowship with the Kavli Foundation, a Research Corporation Innovation Award, a Camille and Henry Dreyfus New Faculty Award, the David Hadas Teaching Award in Arts & Sciences at Wash. U., three Wash. U. Graduate Student Mentoring awards, three Wash. U. Arts & Sciences student-nominated teaching awards, the Wash. U. Freshman Council Professor of the Year Award, and the Wash. U. *Student Life* "Best Professor of the Year" award.

The research in his laboratory focuses on the detailed interrogation and manipulation of reaction dynamics at the molecular and atomic level. Current thrusts include: 1) The categorization of quantum-confinement effects and photo-induced dynamics in semiconductor nanostructures and the development of novel photovoltaic materials. 2) The spectroscopic characterization of bimolecular interactions using clusters to access specific orientations. The experiments utilize an array of tools, including nanosecond and femtosecond lasers, ultrashort pulse shaping, mass spectrometry and ion imaging, absorption and fluorescence spectroscopy, as well as single-molecule and confocal microscopy.