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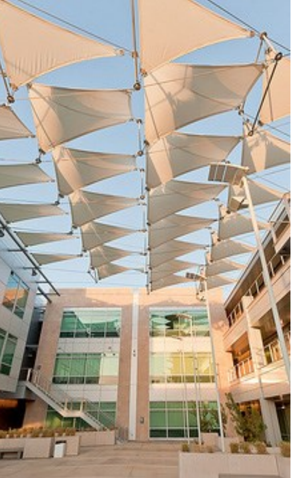

Department of Mechanical Engineering Colloquium

The Department of
Mechanical Engineering
PRESENTS

Michael J. Gordon, Ph.D.

Associate Professor, Dept. of Chemical Engineering
University of California, Santa Barbara

Friday, May 27, 2016
WCH Room 205/206
11:10-12:00PM

Manipulating light with nanostructures: controlling reflection to chemical imaging

Abstract:
This talk will highlight some of our recent work in bio-inspired photonics and plasmonics related to controlling reflection at interfaces and nanoscale chemical imaging. In the former, an easy, scalable and defect-tolerant surface modification protocol, based on colloidal lithography and plasma etching, was developed to create synthetic 'moth-eye' anti-reflective structures on different surfaces for applications in photon detection and extraction. Large increases in transmission, bandwidth, and omni-directional response were obtained in Si, Ge, and GaAs platforms over the mid- and far-IR spectral regions (2-50+ mm) with performance better than commercial coatings. Moth-eye coatings were also implemented in InGaN/GaN quantum well LED structures to enhance light extraction. Effective medium theory, finite difference time domain (FDTD) simulations, and quantitative measurements of transmission, reflection and diffuse scattering were used to understand the ‘photon balance’ of moth-eye films to investigate how scattering phenomena are affected by moth-eye geometry.

In the materials characterization realm, we have developed hybrid atomic force microscopes that manipulate light at 'super resolutions' below the diffraction limit (l/2) to locally image surface structure and chemistry. Nanometer-scale optical fields are created at the apex of an optical antenna tip when laser light excites plasmons (i.e., collective oscillations of free electrons) in the tip material. The resulting field is then used to directly probe molecular vibrations of the surface by way of inelastic light scattering (Raman spectroscopy). Since the optical field enhancement by the tip is truly nanoscale, vibrational spectroscopy and chemically-specific surface imaging below the diffraction limit can be accomplished. All optical, structural- and chemically-specific surface imaging nanowires and organic thin films at spatial resolutions < l/60 will be discussed.

About the Speaker:
Dr. Michael J. Gordon is an Associate Professor in the Department of Chemical Engineering at UCSB. He received his BS/MS in Chemical Engineering from the Colorado School of Mines, MS (Applied Physics) and PhD (Chemical Engineering) from the California Institute of Technology, and spent two years as a post-doc in Grenoble, France at the Laboratoire des Technologies de la Microélectronique (LTM-CNRS). Dr. Gordon joined UCSB in 2007 and is currently the head of the Undergraduate Laboratory in Chemical Engineering. Professor Gordon’s research interests include scanning probe microscopy, plasma physics, plasmonics, spectroscopy, and nanomaterials. Dr. Gordon is a Packard Fellow, received the NSF CAREER award, and was chosen as the Robert E. Vaughn Lecturer at Caltech in 2013. He has also received several department and campus-wide teaching awards.