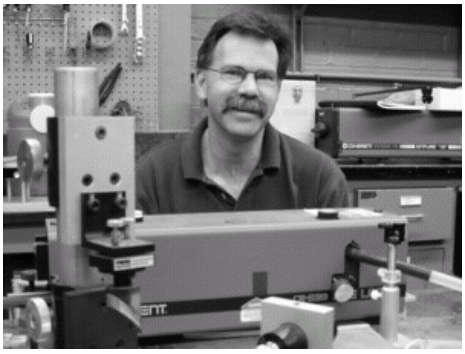
Faculty Profile



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Scott Saavedra

Professor

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Honors

- Associated Western Universities Faculty Fellowship, 1994-95
- Research Fellowship, NSF-Engineering Research Center for Emerging Cardiovascular Technologies, 1989-90

Education and Appointments

- B.S., 1981, University of Maryland (Biochemistry)
- Ph.D., 1986, Duke University (Analytical Chemistry)
- Postdoctoral Fellow 1989-1991, Duke University (Biomedical Engineering)

Research Interests

- Analytical
- Bioanalytical
- Biophysics
- Energy Science
- Instrument Development
- Materials and Polymer Chemistry
- Protein and Membrane Biochemistry
- Spectroscopy/molecular Structure
- Surfaces and Solid State

Research Summary

Bioanalytical Chemistry / Surface Spectroscopy and Spectroelectrochemistry / Waveguides and Interfacial Optics / Chemical and Biological Sensors / Biointerfaces and Biomaterials / Photovoltaic Materials

The multidisciplinary research activities of our group are organized around several overlapping themes: new biointerfaces and thin film biomaterials for molecular device technologies such as chemical and biochemical sensing, new supramolecular assemblies for solar capture and energy conversion, and the development of novel surface spectroscopies and molecular devices based on optical waveguides. Some current projects are:

1. Creation of novel protein and proteo-lipid supramolecular assemblies for biosensing and affinity capture (e.g., Figures 1 and 2). Our fundamental studies of these assemblies seek to elucidate relationships between their structure and biofunction, ultimately leading to creation of advanced bioanalytical technologies.

2. Development of novel waveguide-based, spectroscopic techniques for characterization of surfaces, thin film materials, and interfaces (e.g., Figures 3-5). Spectroelectrochemistry using a planar waveguide geometry has been a focus of much of our recent work.

3. Characterization of the structure and charge transfer properties of heterojunctions between transparent conducting oxide (TCO) electrodes and organic donor films in organic photovoltaic devices (OPVs). These fundamental studies should ultimately lead to enhanced OPV efficiencies (e.g., Figure 4).

4. Development and characterization of thin materials based on supramolecular assemblies of nanocrystals. These materials are being designed as photoelectrochemical catalysts for hydrogen production and as sensitizers in hybrid solar cells (e.g., Figure 5).

A variety of modern analysis tools are used in these projects, including optical waveguide absorbance spectroscopy, total internal reflection fluorescence spectroscopy, transient absorbance spectroscopy, waveguide-enhanced spectroelectrochemistry, atomic force microscopy,

and vacuum surface analysis. Some of these techniques are unique to our laboratory, and are undergoing continuing development, which is facilitated by collaborations with researchers in the Chemistry and Biochemistry Department, other departments on this campus, and other universities.

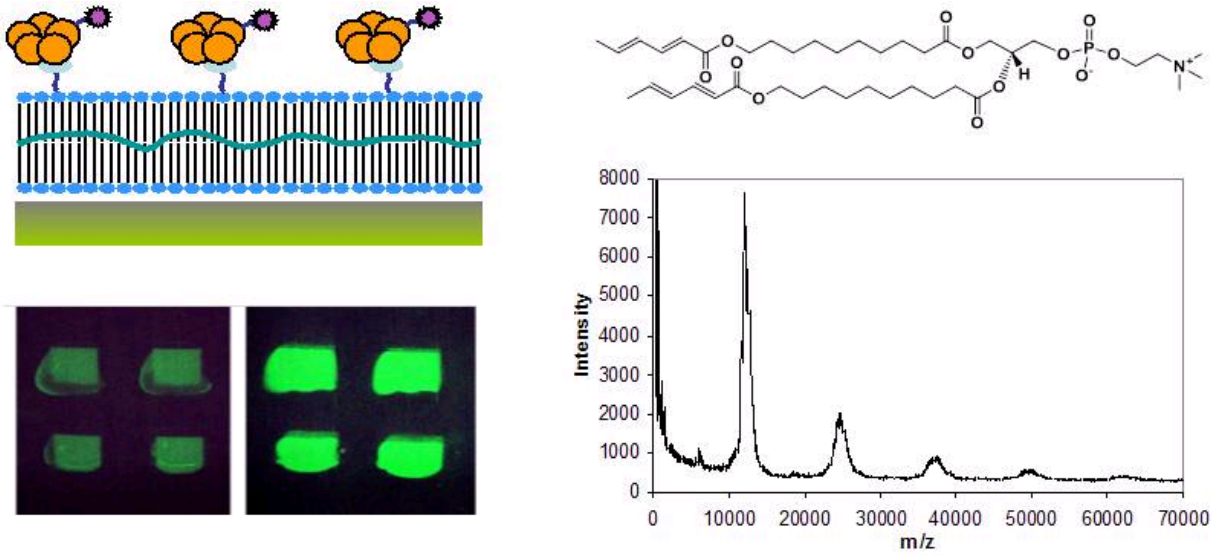


Figure 1. Planar supported lipid bilayers composed of bis-SorbPC, polymerized to enhance stability, for microarray biosensing and affinity capture/mass spectrometry. See publication 93.

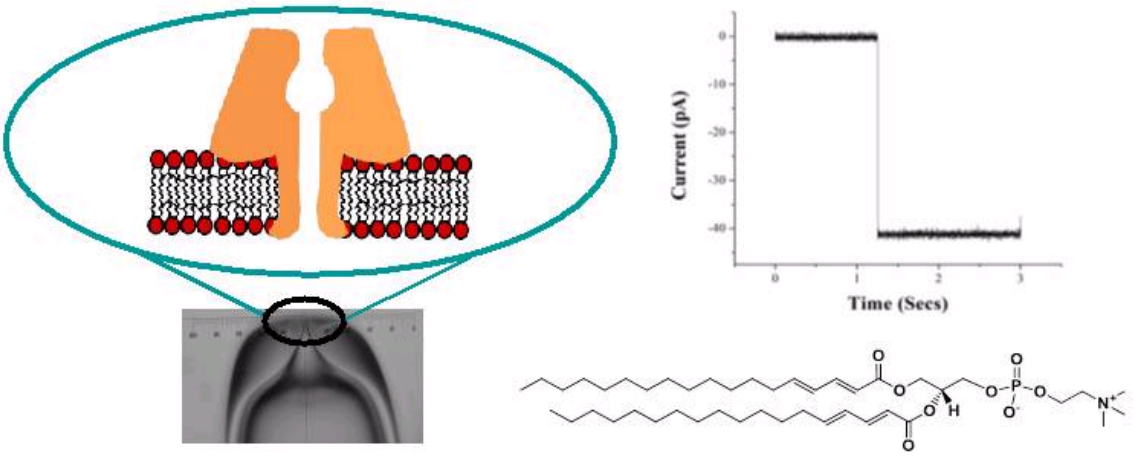
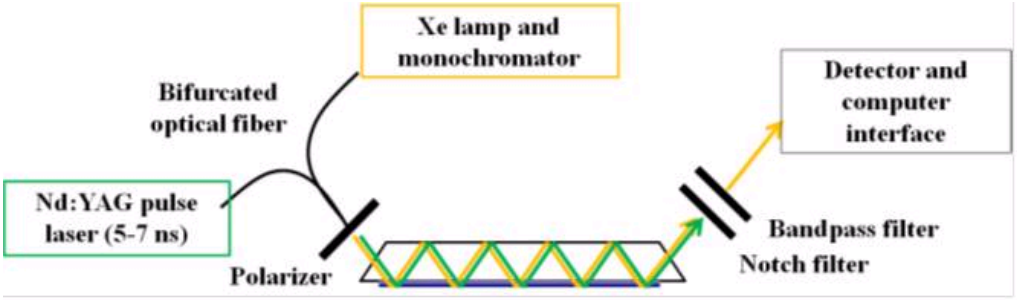


Figure 2. Polymerization of a lipid membrane (composed of bis-DenPC) suspended across a micropipet aperture is used to stabilize an inserted ion channel protein. See publications 92, 99, and 103.



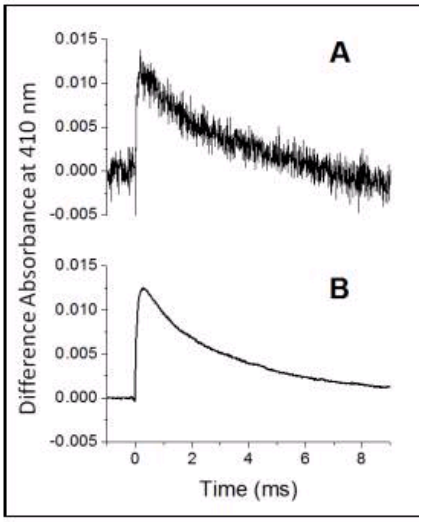


Figure 3. Transient absorbance spectroscopy of thin molecular films: The enhanced pathlength of the waveguide ATR geometry allows for investigation of short-lived species in monolayer and submonolayer films that could not be measured in a transmission geometry. See publication 105.

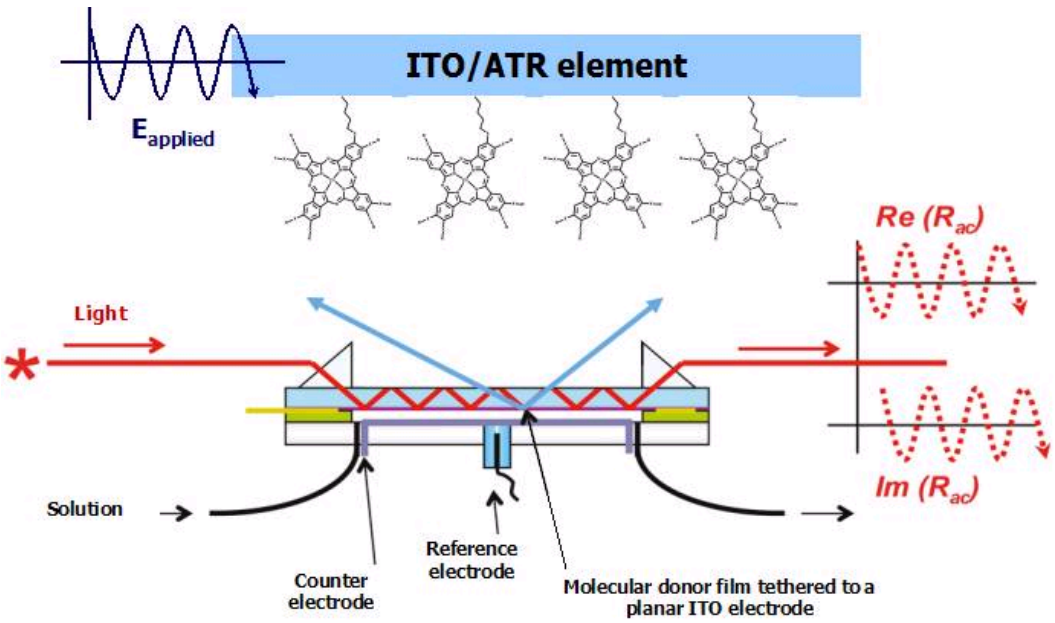
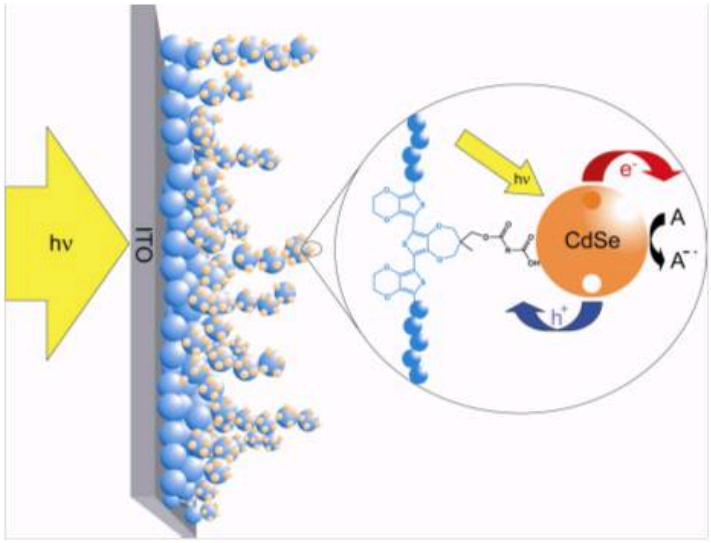


Figure 4. Spectroelectrochemistry in a waveguide ATR geometry: Characterization of charge transfer kinetics of tethered donor monolayers while eliminating non-Faradaic background. See *http://solarinterface.org/*.



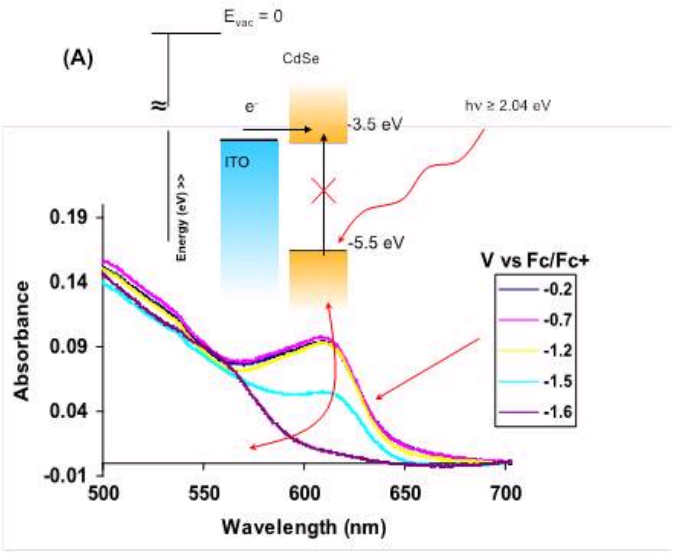


Figure 5. Planar waveguide-based spectroelectrochemistry is used to characterize band energies and charge transfer kinetics in nanocrystal sensitizer films tethered on TCO electrodes. See publication 101.

Selected Publications

- Saliya N. Ratnayaka, El Hadj Elandaloussi, Bryan D. Korth, Robert B. Bates, Jeffrey Pyun, Henry K. Hall Jr., and S. Scott Saavedra, Chem. Phys. Lipids, 2012, 8, 809-812. Studies of Mixed Liposomes with Novel Sorbyl Functionalized Head Group Lipids.
- Hsiao-Chu Lin, Nathan W. Polaske, Luis E. Oquendo, Matthew Gliboff, Kristina M. Knesting, Dennis Nordlund, David S. Ginger, Erin L. Ratcliff, Brooke M. Beam, Neal R. Armstrong, Dominic V. McGrath, and S. Scott Saavedra, J. Phys. Chem. Lett., 2012, 3, 1154-1158. Electron-Transfer Processes in Zinc Phthalocyanine-Phosphonic Acid Monolayers on ITO: Characterization of Orientation and Charge-Transfer Kinetics by Waveguide Spectroelectrochemistry.
- Nathan W. Polaske, Hsiao-Chu Lin, Anna Tang, Mayunk Mayukh, Luis Oquendo, John T. Green, Erin L. Ratcliff, Neal R. Armstrong, S. Scott Saavedra, and Dominic V. McGrath, Langmuir, 2011, 27, 14900-14909. Synthesis and Characterization of Phosphonic Acid Functionalized Asymmetric Phthalocyanines.
- Chenhao Ge, Kristina S. Orosz, Neal R. Armstrong, and S. Scott Saavedra, ACS Applied Materials & Interfaces, 2011, 3, 2677-2685. Poly (aniline) nanowires in sol-gel coated ITO: A pH-responsive substrate for planar supported lipid bilayers.
- Anne M. Simon, Nicole E. Marucci, and S. Scott Saavedra, Anal. Chem., 2011, 83, 5762-5766. Measuring Photochemical Kinetics in Submonolayer Films by Transient ATR Spectroscopy on a Multimode Planar Waveguide.
- Benjamin A. Heitz, Juhua Xu, Ian W. Jones, John P. Keogh, Troy J. Comi, Henry K. Hall, Jr., Craig A. Aspinwall, and S. Scott Saavedra, Langmuir, 2011, 27, 1882-1890. Polymerized Planar Suspended Lipid Bilayers for Single Ion Channel Recordings: Comparison of Several Dienoyl Lipids.
- Jonathan Page, Benjamin A. Heitz, James R. Joubert, John P. Keogh, Tim Sparer, S. Scott Saavedra, Wei He, J. Biomed. Mater. Res. A, 2011, 97, 212-217. An in vitro study of macrophage and fibroblast interactions with planar supported polymerized lipid bilayers.
- Zeynep O. Araci, Clayton. R. Shallcross, Neal. R. Armstrong, S. Scott Saavedra, J. Phys. Chem. Lett., 2010, 1, 1900-1905. Potential-modulated attenuated total reflectance (PM-ATR) characterization of charge injection processes in monolayer-tethered CdSe nanocrystals.
- Erin L. Ratcliff, P. Alex Veneman, Adam Simmonds, Brian Zacher, Daniel Huebner, S. Scott Saavedra, Neal R. Armstrong, Anal. Chem. 2010, 82, 2734-2742. A Planar, Chip-Based, Dual-Beam Refractometer Using an Integrated Organic Light Emitting Diode (OLED) Light Source and Organic Photovoltaic (OPV) Detectors.
- Bo Yun Kim, In-Bo Shim, Zeynep O. Araci, S. Scott Saavedra, Oliver L.A. Monti, Neal R Armstrong, Rabindra Sahoo, Divesh N. Srivastava, and Jeffrey Pyun, J. Amer. Chem. Soc. 2010, 132, 3234-3235. Synthesis and Colloidal Polymerization of Ferromagnetic Au-Co Nanoparticles into Au-Co3O4 Nanowires.
- Han Zhang, James R. Joubert, and S. Scott Saavedra, Adv. Polym. Sci., 2010, 224, 1-42. Membranes from Polymerizable Lipids.
- Han Zhang, Kristina S. Orosz, Hiromi Takahashi, S. Scott Saavedra, Appl. Spectrosc., 2009, 63, 1062-1067. Broadband Plasmon Waveguide Resonance Spectroscopy for Probing Biological Thin Films.
- Zhijie Sui, Nathan J. Hanan, Sam Phimphivong, Ronald J. Wysocki, Jr, and S. Scott Saavedra, Luminescence, 2009, 24, 236-242. Synthesis, characterization, and sol-gel entrapment of a crown ether-styryl fluoroionophore.
- James R. Joubert, Kathryn A. Smith, Erin Johnson, John P. Keogh, Vicki H. Wysocki, Bruce K. Gale, John C. Conboy, and S. Scott Saavedra, ACS Applied Materials & Interfaces, 2009, 1, 1310-1315. Stable, ligand-doped, poly(bis-SorbPC) lipid bilayer arrays for protein binding and detection.
- Benjamin A. Heitz, Juhua Xu, Henry K. Hall, Jr., Craig A. Aspinwall, S. Scott Saavedra, J. Amer. Chem. Soc. 2009, 131, 6662-6663. Enhanced long-term stability for single ion channel recordings using suspended poly(lipid) bilayers.
- David L. Roberts, Yaning Ma, Steven E. Bowles, Colleen M. Janczak, Jeffrey Pyun, S. Scott Saavedra and Craig A. Aspinwall, Langmuir 2009, 25, 1908-1910. Polymer-stabilized phospholipid vesicles with a controllable, pH-dependent disassembly mechanism.
- Varuni Subramaniam, Gemma D'Ambruoso, H. K. Hall, Jr., Ronald J. Wysocki, Jr., Michael F. Brown, and S. Scott Saavedra, Langmuir 2008, 24, 11067-11075. Reconstitution of Rhodopsin into Polymerizable Planar Supported Lipid Bilayers: Influence of Dienoyl Monomer Structure on Photoactivation.
- Saliya N. Ratnayaka, Ronald J. Wysocki, and S. Scott Saavedra, J. Colloid Interface Sci. 2008, 327, 63-74. Preparation and Characterization of Asymmetric Planar Supported Bilayers Composed of Poly(bis-Sorbylphosphatidylcholine) on n-Octadecyltrichlorosilane SAMs.
- Roger Michel, Varuni Subramaniam, Sally McArthur, Bruce Bondurant, Gemma D. D'Ambruoso, Henry K. Hall, Jr., Michael F. Brown, Eric E. Ross, S. Scott Saavedra, David G. Castner, Langmuir, 2008, 24, 4901-4906. Ultra-high vacuum surface analysis study of rhodopsin incorporation into supported lipid bilayers.
- Zeynep Ozkan Araci, Anne F. Runge, Walter J. Doherty III, and S. Scott Saavedra, J. Amer. Chem. Soc. 2008, 130, 1572-1573. Correlating Molecular Orientation Distributions and Electrochemical Kinetics in Subpopulations of an Immobilized Protein Film.

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