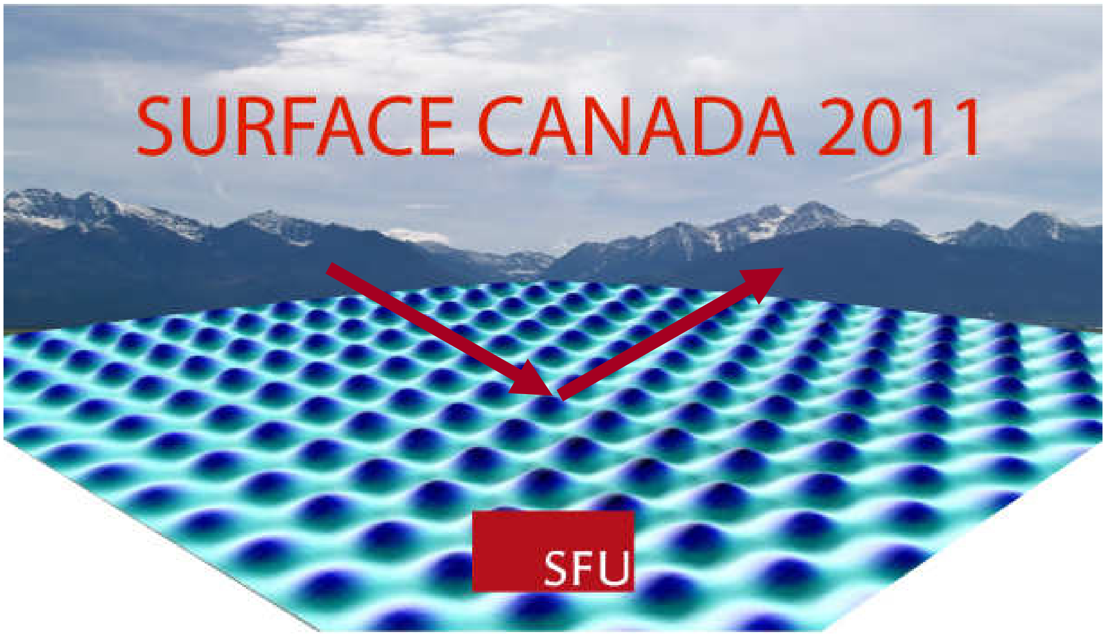


22nd Canadian Conference on Surfaces

13-16 May 2011
Simon Fraser University
Burnaby, British Columbia

Organized for the Division of Surface Science -
A Joint Division of the Canadian Society for Chemistry
and the Canadian Association of Physics

Welcome to Surface Canada 2011 at Simon Fraser University in Burnaby, BC

You can **check in** for the conference (and collect your badges, program booklets and parking passes) during the welcome reception on Friday evening in the Diamond Alumni Centre between 19:00 and 22:00, or on Saturday morning starting at 8:00 am at the registration desk in the Saywell Hall Atrium.

Tours of 4D LABS will be offered over the lunch breaks (12:00-13:30) on both Saturday and Sunday. Sign-up sheets will be available at check-in.
The ***Annual General Meeting of the Division of Surface Science*** will take place on Sunday at 12:30 in Saywell Hall 10081. If you are a member of the Division, please make an effort to attend. We have an outstanding group of invited and contributed presentations planned for SC11, as well as an exciting group of poster presentations. We hope you enjoy the conference

The Organizers.

Gary Leach	Byron Gates
Department of Chemistry and 4D LABS	Department of Chemistry and 4D LABS
Simon Fraser University	Simon Fraser University
(778) 782 8065	(778) 782 8066
gleach@sfu.ca	bgates@sfu.ca

We would like to acknowledge:

- The kind and generous support of our many ***sponsors***, as listed on the next page.
- ***Annie You*** for design and maintenance of the conference web site
- ***Uwe Oehler*** for assistance with abstract submission and programming
- ***Jessica Wong*** for help with budgeting and planning
- ***Justin Ankenmann*** of ***SFU Meeting, Event and Conference Services*** for his assistance with registration, set-up and organization.
- ***Vivian Tan*** and ***Chartwells Catering*** for the food and beverages provided.
- ***Dan Falk*** for design of the conference logo
- ***Dana Beaton*** and ***Katelyn D'Angio*** of ***SFU Conference and Guest Services***
- Our many student volunteers: ***Brandy Kinkead, Donna Hohertz, Reagan Belan, Ricky Chu, Shira Halperin, Ryan Roberts, Stanley Chang, Michael Wang, Shakiba Mahmoudi, Birgit Oberleitner, Idah Pekcevik, Mike Paul, Amir Nazemi, Clark Zhao, Him Wai Ng, Iris Zuo, Amelia Liu, James Zhou, the Chemistry Graduate Student Caucus, and the Physics Graduate Student Caucus.***

Instructions for Speakers:
Invited talks are 50 min in duration including ~5 min for discussion.
Contributed talks are 30 min in duration including ~5 min for discussion.
We recommend you bring a PowerPoint or equivalent format of your presentation on a USB storage device and pre-load your presentation onto the presentation computer prior to the start of the session in which you are presenting. Other arrangements are available upon request.

Instructions for Poster Presenters:
You will have a 4' x 4' area for your poster. Push pins will be provided. If required, a volunteer will be available to assist you. We recommend that you set up your poster at lunch on Saturday. Presenters are expected to be present at their posters between 17:10 – 19:10 on Saturday. Posters can remain on display until Sunday afternoon at the discretion of the presenter.

Surface Canada 2011
22nd Canadian Conference on Surfaces
…thanks our generous sponsors:

SYSTEMS FOR RESEARCH
SFR
MAGNIFYING NANOSCIENCE

CHEMISTRY
Simon Fraser University

ASYLUM RESEARCH
The Technology Leader in SPM/AFM

COHERENT.

SPECS™

CCR
PROCESS PRODUCTS

Kurt J. Lesker® Company

sfss.ca

OCI Vacuum Microengineering
Surface - Vacuum Analytical Instruments & Technology

4D LABS

Continuum®
The High Energy Laser Company™

SFU

ProSpect Scientific Inc. & Renishaw Inc.

Friday PM

Diamond Centre

22nd Canadian Conference on Surfaces

Chair(s) - Byron Gates, Gary Leach

From **19:00** until **22:00**

WELCOME RECEPTION

Saturday AM

Saywell Hall 10081

22nd Canadian Conference on Surfaces

Chair(s) - Gary W. Leach

09:00 Introductory Remarks

09:10 0001 *Hydrogen Gas Detection at Palladium Nanowires* *$**Penner R.M.**, Yang F.

10:00 0002 *Controlling the deposition of Pt nanoparticles within the surface region of Nafion* Sode A, Ingle NJC, McCormick M, Gyenge E, Wilkinson DP, ***Bizzotto D**

10:30 Coffee Break

11:00 0003 *Mega-Gauss in Nanobubbles: Giant pseudo-magnetic fields in strained graphene* ***Burke S.A.**, Levy N., Meaker K.L., Panlasigui M., Zettl A., Guinea F., Castro Neto A.H., Crommie M.F.

11:30 0004 *Effect of annealing on* $Co_2FeAl_{0.5}Si_{0.5}$ *thin films* ***Trudel S**, Elmer HJ, Hamrle J, Hillebrands B, Inomata K

12:00 End of Session

Lunch

Exhibition

4D LABS Tours

ChemQuest: Academic Quadrangle (13:30-14:00)

Saturday PM

Saywell Hall 10081

22nd Canadian Conference on Surfaces

Chair(s) - Simon Trudel

14:00 0005 *Surface Chemical Properties of Metal Phosphide Catalysts for Upgrading Crude Oil and Biomass to Transportation Fuels* *$**Bussell M. E.**, Bowker R. H., Smith M. C., Hayes J. R.

14:50 0006 *The Effect of Switchable Additives on Colloidal Interactions found in Oil Sands By Chemical Force Spectrometry* Lau Y, Jessop P, *$**Horton JH**

15:20 Coffee Break

15:50 0007 *Studying kinetic effects in film growth using a nanostencil: Ag on Si(001)* To N, *$**Nogami J**

16:10 0008 *Piezoresponse force microscopy of relaxor ferroelectrics* **Bokov A. A.**, Ye Z.-G.

16:40 0009 *Structured Surfaces from Electro-"polishing"* *$**Kruse P.**, Pantaleo A., Baig S.A., Zolfaghari A., Pauric. A., Wang Y.

Saywell Hall Atrium

POSTER SESSION AND BBQ

From **17:10** until **20:10**

0010 *Exploring the Mechanism of Functonalized Silica Supported Pd Catalysts for Heck and Suzuki-Miyaura Reactions* Hanif M, Ebralidze I, *$**Horton JH**

0011 *Characterization of Nanoporous Gold Surfaces for Applications in Glucose Sensing* $**Paul M.T.Y.**, *Gates B.D.

0012 *Minimizing Defects in Self-Assembled Monolayers (SAMs)* **Gong Y**, *Wang M, $Gates B

0013 *Photodissociation Mechanisms of* CH_3I *Adsorbed on* $D_2O/Cu(110)$ *$**Jensen E.T.**

0014 *Rotationally averaged intermolecular potentials for monolayer* $H_2/MgO(001)$ **Kootnekoff B A**, Makins C, Hawrylo J, *$Jack D B

0015 *Development of an aptamer-based electrochemical biosensor for the detection of cancer marker MUC-1* **Ho C**, *$Yu HZ

0016 *Exploring Chemical Modification of Graphene* **Bobak J.**, Collins D.J., Dumaisnil K., *$Steuerman D.W.

0017 *Energy and Conformation of Glycinate* ($NH_2CH_2COO^-$) *on Cu(110)* **Abd-El-Aziz A**, *$Jack D B

0018 *Nanostencil patterning of In and Sn on atomically clean Si(001)* **To N**, Dobrin S, *$Nogami J

0019 *Electrochemically Controlled Interaction of Liposomes with a Lipid-like Layer* **Musgrove A**, *$Bizzotto D

0020 *Large Scale Crystallinity in Polythiophene-Based Langmuir-Blodgett Films: Imaging Conducting Polymers at the Molecular Level* *$**Leach G.W.**, Mattu J., Han J.

0021 *Investigating the fate of reductively desorbed molecules from self assembled monolayers* Casanova-Moreno J.R., *$**Bizzotto D.**

0022 *Photothermal Treatment of LCAM Cancer Cells Using Polyethylene Glycol-Modified Gold Nanorods* $**Pekcevik I. C.**, Zhou J., Oberleitner B., Wang M.C.P., *Semetey V., Gates B.D.

0023 *Effect of Buffer Composition and Solution Temperature on the Stability of Gold Nanoparticles with Modified Surface Chemistries* **Mahmoudi M.**, *Pekcevik I., Paul M., $Gates B.

0024 *Development of Metastable Atom De-excitation Spectroscopy for the Study of Physical and Electronic Surface Structure* **Read ST**, Lyagusha A, [*$]Rowntree PA

0025 *Optimizing the formation of biocompatible gold nanorods (GNR) to target cancerous cells: functionalization, stabilization and purification* [*]**Oberleitner B.**, Bogliotti N., Schmidt F., Florent J.-C., Johannes L., [$]Semetey V.

0026 *Large-Area and Uniform Honeycomb Structured Film Fabricated by PS-b-P2VP Block Copolymer* **Kim J.**, Lew B., [*$]Kim W. S.

0027 *Shape Controlled Electrodeposited Metal Particles on Gold Thin Film Electrodes* [$]**Han Y.Y.**, McCague C., [*]Leach G.W.

0028 *Photo-curable Silver Nanoparticle Ink for Direct Stamping of Thick Micro-Patterning* **Hsieh L.H.**, Wong, [*]Kim W.S.

0029 *A USB-powered, stand-alone electrochemical biosensor prototype for point-of-care medical diagnosis* [$]Loncaric Carlyn, **Tang Yiting**, Ho Cassie, Parameswaran Ash, [*]Yu Hogan

0030 *Fabrication of Platinum Nanoparticle Decorated Porous Niobium Oxide Catalyst Layers for Fuel Cell Applications* **Kinkead B**, Gates BD

Sunday AM

Saywell Hall 10081

22nd Canadian Conference on Surfaces

Chair(s) - Byron Gates

09:00 0031 *Atmospheric Heterogeneous Photochemistry* [*$]**Donaldson D.J.**

09:50 0032 *Combining nonlinear vibrational spectroscopy, electronic structure calculations, and molecular simulations to characterize the structure of molecules adsorbed at solid-liquid interfaces* [*$]**Hore DK**, Hall SA, Jena KC, Covert PA, Roy S

10:20 Coffee Break

10:50 0033 *Imaging the Kinetics of Single Molecules at Lipid Membranes and Charged Surfaces* **Harris J. M.**, Fox C. B., Myers G. A., Peterson E. M.

11:40 0034 *Surface-Immobilized DNA Aptamer Constructs as Electronic Biosensing and Switching Nano-devices* **Chakraborty B.**, [*]Sen D., [$]Yu H-Z.

12:10 End of Session

Lunch

Exhibition

4D LABS Tours

Sunday PM

Saywell Hall 10081

22nd Canadian Conference on Surfaces

Chair(s) - Peter Kruse

Hobson Award Symposium

13:30 0035 *Electrodeposition of metal on GaAs nanowires* **Liu C**, Einabad O, Watkins S, Kavanagh K

14:00 0036 *Modifying the Surface Chemistry of Selenium Nanowires via UV-Initiated Reaction* **Wang Michael C**, [*$]Gates Byron D.

14:30 0037 *Surface effects in chiral adsorption* **Popa T.**, Paci I.

15:00 0038 *Recrystallization of Electrodeposited Copper Thin Films* [*$]**Alshwawreh N**, Militzer M, Bizzotto D, Kuo J

15:30 Coffee Break

16:00 0039 *Simulation of water vibrational response next to solid surfaces* **Roy S**, Roth HM, [*$]Hore DK

16:30 0040 *Using a surface template to control the width of rare earth silicide nanowires on the Si(001) surface* **Cui Y**, [*$]Nogami J

17:00 0041 *Electrooxidation of Carbon Monoxide on Palladium* [$]**Sacci R L**, [*]Harrington D A

17:30 0042 *Behavior of Chemisorbed Azobenzene on Gold Surfaces: Computational Study at the Zero-density Limit* **Chapman C. R. L.**, [*]Paci I.

Diamond Centre (19:00)

BANQUET

Monday AM

Saywell Hall 10081

22nd Canadian Conference on Surfaces

Chair(s) - Sarah Burke

09:10 0043 *X-ray Spectromicroscopy of Oriented and Strained Surfaces* [*$]**Urquhart S.G.**

10:00 0044 *Redox driven coherent incoherent structural transform of VOx on* $TiO_2(110)$ [*$]**Kim C.-Y.**, Elam J.W., Stair P.C., Bedzyk M.J.

10:30 Coffee Break

11:00 0045 *Effect of precursor chemistry on the growth of III-V semiconductor nanowires* Salehzadeh O, **Watkins S P**

11:30 0046 *On-command photochemistry using upconverting nanoparticles* **Boyer J. C.**, Carling C. J., Gates B. D., [*$]Branda N. R.

Closing Remarks

12:05 End of Session

1 09:10 Saturday Saywell Hall 10081

Hydrogen Gas Detection at Palladium Nanowires **R.M. Penner**[*$] <*rmpenner@uci.edu*> and **F. Yang** <*fyang1@uci.edu*>, Department of Chemistry, University of California, Irvine, Irvine, CA 92697-2025.

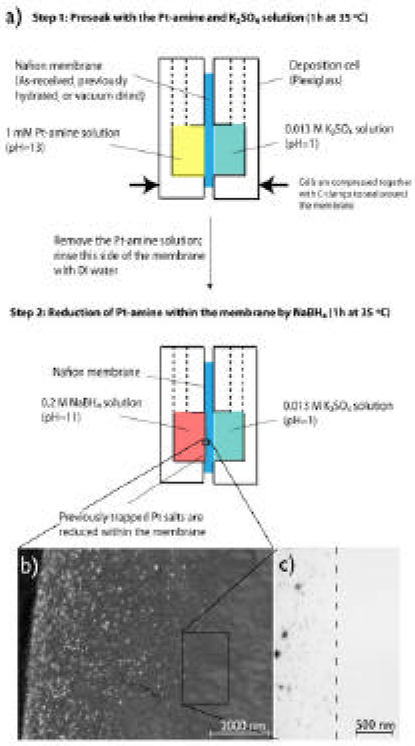
Noble metal nanowires have attributes including strength, ductility, and chemical stability that make them attractive candidates for chemical sensing applications. We have developed a new method for preparing arrays of noble metal nanowires that involves the electrodeposition of metals (palladium, silver, platinum and gold) onto lithographically patterned glass surfaces. Under the conditions employed for nanowire growth, metal is deposited within this patterned photoresist layer on a sacrificial nickel electrode leading to the formation of polycrystalline nanowires that are up to 1 cm in length and 5-200 nm in lateral dimension. The palladium nanowires prepared using this method, called lithographically patterned nanowire electrodeposition or LPNE, can form the basis for chemical sensors in which the resistance of the nanowire is modulated by molecules that chemisorb on its surface. One particularly interesting example involves palladium nanowires in the presence of hydrogen gas. For this system, Pd nanowires respond to H_2 exposure by becoming either more resistive or more conductive, depending on the details of nanowire and sensor fabrication. What is the origin of these resistance changes? What factors control the rate of response to, and recovery from, hydrogen gas exposure and what is the sensitivity of the nanowire to hydrogen? In this talk, we focus attention on these issues and we'll discuss the prospects for developing practical hydrogen sensors designed to rapidly, sensitively, and cheaply detect leaked H_2 gas.

---

2 10:00 Saturday Saywell Hall 10081

Controlling the deposition of Pt nanoparticles within the surface region of Nafion **NJC Ingle** and **D Bizzotto**[*a,b], [a]AMPEL, UBC; **A Sode**, **M McCormick**, **E Gyenge** and **DP Wilkinson**, Dept of Chemical and Biological Engineering, UBC; [b]Dept of Chemistry,, UBC.

New methods for creating membrane electrode assemblies is desirable in an attempt to improve the performance of electrochemical reactors like the PEM fuel cell. The creation of Nafion impregnated with Pt nanoparticles only in the surface region will be described. Characterization of these membranes was performed using SEM and TEM and electrochemical surface area measurements. The important parameters that control this process are the hydration state and history of the Nafion membrane, the pH of the solutions used in the process. Results will also be presented that detail the nano-morphology of the hydrophilic regions, or water channels in Nafion. We show the existence of bundles of Pt nanorods that are 2nm in diameter and 10 - 20 nm long, similar to the recent reports of the Nafion water channel morphology.



3 11:00 Saturday Saywell Hall 10081

Mega-Gauss in Nanobubbles: Giant pseudo-magnetic fields in strained graphene

S.A. Burke* <*saburke@phas.ubc.ca*>, Department of Physics & Astronomy and Chemistry, UBC, Vancouver BC; **N. Levy**, NIST, Gaithersburg MD; **K.L. Meaker**, **M. Panlasigui**, **A. Zettl** and **M.F. Crommie**, Department of Physics, U.C. Berkeley, Berkeley CA; **F. Guinea**, Instituto de Ciencia de Materiales de Madrid. CSIC, Madrid ,Spain; **A.H. Castro Neto**, Department of Physics, Boston University, Boston MA.

The intense work on graphene over the past several years has resulted in the discovery of many intriguing properties of this seemingly simple material. Recent calculations have predicted one such unusual effect in graphene: that electrons in strained graphene may behave as if under the influence of an applied magnetic field. If the strain corresponds to a triangular geometry, the strain-induced "pseudo-magnetic field" is nearly uniform, and should give rise to a Quantum Hall Effect. Achieving this effect requires the generation of large non-uniform strains in a specific geometry, making experimental observation challenging.

Graphene can be grown by in situ chemical vapor deposition on a Pt(111) surface by exposure to ethylene at high temperature. When cooled to the measurement temperature of <10K, this generates nanoscale bubbles in the graphene strained to ~10% in a three-fold symmetric geometry. I will describe our recent low-temperature scanning tunnelling microscopy measurements of these "graphene nanobubbles" grown under strictly controlled ultrahigh vacuum conditions. Scanning tunnelling spectroscopy measurements exhibit sequences of peaks in LDOS that can be attributed to Landau levels arising from strain-induced pseudo-magnetic fields of over 300 Tesla. The observation of such enormous pseudo-magnetic fields opens the door for room temperature "strain-tronics", as well as the study of charge carriers in extreme magnetic field regimes.

---

4 11:30 Saturday Saywell Hall 10081

Effect of annealing on Co$_2$FeAl$_{0.5}$Si$_{0.5}$ thin films

S Trudel* <*trudels@ucalgary.ca*>, Univeristy of Calgary; **HJ Elmer**, Mainz University; **J Hamrle** and **B Hillebrands**, TU Kaiserslautern; **K Inomata**, NIMS, Japan.

Cobalt-based Heusler compounds are attracting significant attention due to their predicted high spin polarization, making them ideal materials for spintronic applications. Of these compounds, Co$_2$FeAl$_{0.5}$Si$_{0.5}$ has emerged as a champion material do the Fermi level tuning afforded by the quaternary composition.

In this talk, I will discuss the effect annealing has on 30 nm thick single-crystal epitaxial Co$_2$FeAl$_{0.5}$Si$_{0.5}$ thin films. In particular, magneto-optical probes such as surface magneto-optical Kerr effect magnetometry, Brillouin light scattering spectroscopy, and soft x-ray absorption spectroscopy have beed used to probe various magnetic properties such as anisotropy, quadratic magneto-optical effects, exchange interactions, and the spin and orbital moments using x-ray magentic circular dichroism (XMCD). XMCD at the metal edges were carried out in total electron yield and transmission modes, allowing a direct comparison of the magnetism at the surface and in the bulk of the film. We find the surface moments are reduced at the Co$_2$FeAl$_{0.5}$Si$_{0.5}$ / MgO interface with respect to the bulk, pointing to potential gains in device performance should this MgO / Co$_2$FeAl$_{0.5}$Si$_{0.5}$ be optimized.

5 14:00 Saturday Saywell Hall 10081

Surface Chemical Properties of Metal Phosphide Catalysts for Upgrading Crude Oil and Biomass to Transportation Fuels **M. E. Bussell**[*$] <*mark.bussell@wwu.edu*>, **R. H. Bowker** <*rickbowker@gmail.com*>, **M. C. Smith** <*forbycorp@gmail.com*> and **J. R. Hayes** <*jrh154 @mail.usask.ca*>, Dept. of Chemistry, MS-9150, Western Washington University, Bellingham, WA 98225, USA.

Supported noble metal catalysts are highly active for deep hydrodesulfurization (HDS) applications and also show promise for use in the hydrodeoxygenation (HDO) of bio-oils. In this study, the HDS and HDO properties of noble metal phosphide catalysts will be compared to those of noble metal and commercial Co-Mo and Ni-Mo catalysts. Noble metal phosphides (RuP, Ru_2P Rh_2P, Pd_3P) supported on silica were prepared and their properties for dibenzothiophene HDS and furan HDO were investigated. As an example, a 5 wt% Rh_2P/SiO_2 catalyst was observed to be over three times more active than a 5 wt% Rh/SiO_2 catalyst for dibenzothiophene HDS. The product selectivities of the Rh_2P/SiO_2 and Rh/SiO_2 catalysts differed substantially, with the Rh phosphide catalyst more strongly favoring hydrogenated products. For furan HDO, a Ru_2P/SiO_2 catalyst was observed to be nearly three times more active than a Ru/SiO_2 catalyst and to exhibit more favorable product selectivity. The differences in catalytic properties of the noble metal and noble metal phosphide catalysts will be rationalized in terms of their solid-state and surface chemistry.

6 14:50 Saturday Saywell Hall 10081

The Effect of Switchable Additives on Colloidal Interactions found in Oil Sands By Chemical Force Spectrometry **Y Lau** <*Ying.Lau@chem.queensu.ca*>, **P Jessop** <*philip.jessop@chem.queensu.ca*> and **JH Horton**[*$] <*hortonj@chem.queensu.ca*>,
Department of Chemistry, Queen's University, Kingston, ON, Canada.

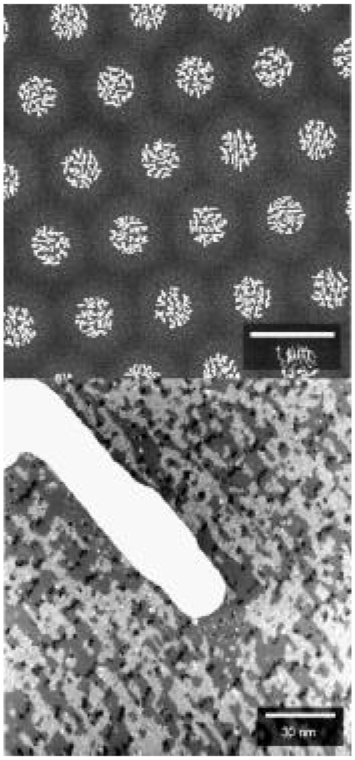
Manipulation of colloidal interactions between bitumen and mineral surfaces is a crucial factor affecting bitumen recovery in oil sands separations. Additives that improve bitumen recovery during the separation stage are often determimental to clarification of processing water in the tailings pond if the water is not treated beforehand. CO2-mediated switchable additives may be potential processing aids that require minimal treatment and facilitate recycling of the processing water. Here, the effect of CO2-mediated switchable additives on colloidal interactions found in model oil sands were studied by chemical force spectrometry. Self-assembled monolayers (SAM) of 12-phenyldodecanethiol and 12-mercaptododecanoic acid were used to chemically modify gold-coated atomic force microscope (AFM) tips. These were subsequently used to study the adhesion force between the modified tips and the minerals silica and mica. The adhesion between the tips and the mineral substrates were studied in aqueous solutions of varying pH; divalent cation concentration; and in the presence of cationic switchable additives, both in the presence and absence of CO2. Some of the change in interaction forces may simply be accounted for by pH changes induced by the dissolution or removal of CO2 from the surfactant solution. But a significant portion of the change in adhesion force results from the CO2-mediated switching of the additive from its neutral to cationic (i.e. surfactant) form. These results are discussed in the context of the mechanism of colloidal interactions in an oil sands system.

7 15:50 Saturday Saywell Hall 10081

Studying kinetic effects in film growth using a nanostencil: Ag on Si(001)

N To <*nelson.to@utoronto.ca*> and **J Nogami***$ <*jun.nogami@utoronto.ca*>, Materials Science and Engineering, University of Toronto.

At room temperature, Ag grows on the Si(001) surface in a pseudo-Stranski-Kranstanov mode; the first layer is complete at one monolayer, and then there is the nucleation of 3D islands at which point the 2D layer also partially unwets the surface [1]. Another study has confirmed that a 1 ML film is metastable above 0.55 ML, and will dewet the surface [2]. Here we analyze new STM data to determine the length scales for the dewetting. In addition, we use a nanostencil to make Ag dots of various coverages and examine how the spreading behavior gives us additional insight into the energetics that drive some of the film growth phenomena that have been observed.



[1]J.C. Glueckstein, et al, PRB 54, R11066 (1996)
[2]D.E. Starr et al, PRL 87, 106102 (2001)

8 16:10 Saturday Saywell Hall 10081

Piezoresponse force microscopy of relaxor ferroelectrics

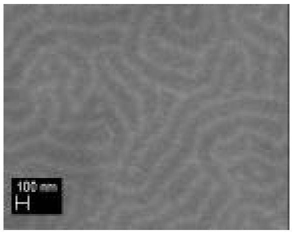
A. A. Bokov <*abokov@sfu.ca*> and **Z.-G. Ye** <*zye@sfu.ca*>, Department of Chemistry and 4D LABS, Simon Fraser University, , Burnaby, British Columbia, V5A 1S6, Canada.

During the last two decades when piezoresponse force microscopy (PFM) has been developed it has proved to be a powerful tool for studying ferroelectrics. In spite of the fact that PFM samples only the near-surface layer (several dozens of nanometers) the obtained information is important for general understanding of the domain structure, local properties and inhomogeneities of ferroelectrics materials. Quite recently PFM technique has been applied to investigate relaxors, which are a special class of ferroelectrics characterised by nanoscale domains and unique properties related to the heterogeneous structure.

In the present talk we report our recent studies of classical relaxor ferroelectrics including $(1\text{-}x)PbMg_{1/3}Nb_{2/3}O_3\text{-}xPbTiO_3$ and $(1\text{-}x)PbZn_{1/3}Nb_{2/3}O_3\text{-}xPbTiO_3$ single crystals and $Pb_{1-x}La_xZr_{0.65}Ti_{0.35}O_3$ ceramics. Using PFM made it possible to observe and explore a number of effects hardly accessible by other experimental methods. In particular, we discovered spatial mesoscopic heterogeneity in the dynamics of polarisation relaxation behaviour, found that the piezoelectric d_{33} coefficient is significantly reduced within the distance of 1 µm from the uncharged engineered domain walls, proved the existence of static polar nanoregions in ergodic relaxor phase, elucidated the role of quenched random local fields in formation of polar nanoregions and polarization reversal, showed that the surface of relaxors undergoes a mesoscopic symmetry breaking leading to the freezing of polarization fluctuations and shift of the Curie temperature.

9 16:40 Saturday Saywell Hall 10081

Structured Surfaces from Electro-"polishing" **<u>P. Kruse</u>**[*$] <*pkruse@mcmaster.ca*>, **A. Pantaleo**, **S.A. Baig**, **A. Zolfaghari**, **A. Pauric.** and **Y. Wang**, Department of Chemistry and Chemical Biology, McMaster University, 1280 Main Street W., Hamilton, ON, L8S4M1, Canada.



The traditional goal of electropolishing is the formation of flat surfaces. We (and others) have shown in the past that interesting nanostructures may be imparted in certain regions of parameter space.[1] Conventional electropolishing would either avoid these parameter sets or tolerate the nanostructures as long as the surface was sufficiently flat at the micrometer scale or above. The interest in exploiting these phenomena as a fabrication method for nanotechnology is relatively recent and there is no model or theory available yet to guide the search for regions in parameter space that yield useful structures. Regular, hexagonal arrays of nanoscale dimples have been reported by us in the past. [1] We also report stripe and labyrinthine patterns and are currently trying to understand the phase transitions between the different types of patterns, which depend on polishing conditions rather than surface structure. We are trying to understand a very recent discovery of current oscillations during nickel electropolishing that are correlated to terrace-like structures. More recently, we have also discovered the formation of sponge layers on a variety of metal surfaces during "electropolishing" in highly concentrated acids. Mass transport limitations appear important, gas evolution at the anode or nature of the acid do not seem to play a role. The nanoscale pores do not follow crystallographic features of the substrate, and the surface of the substrate becomes flat at the micrometer scale and above. These sponge layers have potential applications in catalysis, photovoltaics, smart fuses for bombs and current collectors in batteries.

[1] Singh, S.; Barden, W. R. T.; Kruse, P., ACS Nano 2008, 2, 2453-2464.

10 17:10 Saturday Saywell Hall Atrium

Exploring the Mechanism of Functonalized Silica Supported Pd Catalysts for Heck and Suzuki-Miyaura Reactions **M Hanif** <*hanifm@chem.queensu.ca*>, **I Ebralidze** <*ebralidze@chem.queensu.ca*> and **<u>JH Horton</u>**[*$] <*hortonj@chem.queensu.ca*>, Department of Chemistry, Queen's University, Kingston, Ontario.

Over the last few decades, palladium catalyzed cross-coupling reactions, such as Heck or Suzuki-Miyaura, have gained particular attention for their role in the synthesis of pharmaceuticals ingredients. However, the separation of the catalysts from the reaction product, both for subsequent recycling of the Pd, and for product purification, remains a challenge. Here, we report on the development of a model heterogeneous Pd catalyst supported on a 3-mercaptopropyltrimethoxysilane(MPTMS)-functionalized Si (111) wafer. The catalysts were characterized by surface analytical techniques such as x-ray photo electron spectroscopy (XPS), auger electron spectroscopy (AES), atomic force microscopy (AFM) and water contact angle measurements. In an effort to better understand the catalysis mechanism, the prepared catalysts will be applied in Heck and Suzuki-Miyaura reaction conditions. The dissolution, if any, of the catalyst will be analyzed by using a specially designed micro-reactor. Structural change on the catalyst surface will be investigated by XPS and AES focusing on Pd, S and Si spectra and surface topographic change will be observed by using AFM before, during and after the reaction. Determining the extent of catalysts dissolution during the reaction and analyzing the oxidation state and electronic environment of thiolated palladium by spectroscopic methods, will be an approach to understand both the mechanism of the heterogeneous Pd catalyst, and to explore new methods for immobilizing the Pd on the catalyst surface, reducing contamination of the product.

11 17:10 Saturday Saywell Hall Atrium

Characterization of Nanoporous Gold Surfaces for Applications in Glucose Sensing

M.T.Y. Paul[$] *<mpaul@sfu.ca>* and **B.D. Gates**[*] *<bgates@sfu.ca>*, Simon Fraser University, Department of Chemistry and 4D LABS, 8888 University Drive, Burnaby, BC V5A 1S6 Canada.

Nanoporous materials have a high surface area to volume ratio. In applications where reactions were carried out at the material surface, the nanoporosity will enhance the efficiency of these reactions. Nanoporous gold was sought for its use in creating electrochemical sensors for detecting specific molecules in biological environments. In our study, tunable nanoporous gold electrodes were fabricated using a sacrificial template. The assembled nanostructures were analyzed by electron microscopy and cyclic voltammetry techniques to assess its suitability for use as a porous electrode. The nanoporous gold electrode contained ~150nm diameter pores over an area of ~0.3cm^2, but could be scaled to cover larger areas as well as tuned to different pore sizes. These nanoporous gold electrodes were compared to planar gold electrodes by cyclic voltammetry. The sensitivity of each electrode was compared for their ability to detect dissolved glucose at a range of concentrations. The results suggest that this electrochemical process was diffusion limited and that the relative sensitivity of the porous electrode can be increased to >50 times in comparison to that of the planar electrode. Surface oxides were also analyzed to estimate relative surface area of each electrode. The porous electrodes had an electrochemically active surface area of ~30 times larger than their planar counterpart. The nanoporous electrodes were further tuned by different methods of glucose oxidase immobilization to overcome the diffusion limitations and achieve improved peak resolution. Nanoporous gold electrodes required different optimizing parameters, but exhibit a greater overall performance in electrochemical sensing than planar electrodes. These nanoporous gold surfaces can be used in applications for enhanced chemical and biological sensing.

12 17:10 Saturday Saywell Hall Atrium

Minimizing Defects in Self-Assembled Monolayers (SAMs)

Y Gong *<yga21@sfu.ca>*, **M Wang**[*] and **B Gates**[$], Simon Fraser University, Department of Chemistry and 4D LABS.

A popular and simple technique for modifying the surface properties of a material is through the growth of self-assembled monolayers (SAMs). These single molecule thick layers are used for a variety of applications, such as resisting the non-specific adsorption of proteins for applications in biosensors or medical devices. Other applications include the use of SAMs as a low friction coating on materials. In order to pursue these and related applications, we are interested in the integrity of fluorocarbon containing silane based SAMs on silica surfaces. Silica is of particular interest for both its relatively low cost and widespread acceptance as a substrate for the construction of biosensors and medical devices. These substrates are typically modified with silane-based SAMs, which are prone to a variety of defects. Our goal is to minimize the defects in these SAMs coated onto the surfaces of silicon oxides. We investigated the quantity and type of defects in these SAMs through multiple steps of silane deposition and extraction. Optimal reaction conditions were determined by tuning temperature, silane concentration, and water content. Techniques such as X-ray photoelectron spectroscopy, ellipsometry, and water contact angle measurements have been used in order to assess the quality of these monolayers.

13 17:10 Saturday Saywell Hall Atrium

Photodissociation Mechanisms of CH_3I Adsorbed on $D_2O/Cu(110)$ **E.T. Jensen**[*$] <*ejensen@unbc.ca*>, Department of Physics, University of Northern BC, Prince George B.C. V2N 4Z9.

Excitation of adsorbed molecules by UV light or low energy electrons are important processes in a variety of diverse systems, such as lithography[1], radiobiology [2], ozone depletion in polar stratospheric clouds[3], and on the surfaces of icy particles in the interstellar medium[4]. These excitations can be driven by conventional neutral photochemistry, as well as by the action of low energy photoelectrons causing electron driven chemistry such as dissociative electron attachment (DEA). We have begun studying photochemical processes in molecular ices using the CH_3I chromophore adsorbed with water ice (here using D_2O). Previous work had implicated low energy photoelectrons as the most significant driver of observed photochemistry in this system[5], while our results demonstrate that neutral photochemistry is the dominant process at the wavelengths of our study.

1. P. A. Sloan and R. E. Palmer, Nature 434, 367 (2005).
2. L. Sanche, Eur. Phys. J. D 35, 367 (2005).
3. S. Solomon, Rev. Geophys. 37, 275 (1999).
4. B. T. Draine, Annu. Rev. Astron. Astrophys. 41, 241 (2003).
5. Y. Sohn and J. M. White, Bull. Korean Chem. Soc. 30 (7), 1470-1474 (2009).

---

14 17:10 Saturday Saywell Hall Atrium

Rotationally averaged intermolecular potentials for monolayer H_2/MgO(001) **B A Kootnekoff**, **C Makins**, **J Hawrylo** and **D B Jack**[*$] <*david.jack@ubc.ca*>, Department of Chemistry, University of British Columbia.

The adsorption of hydrogen molecules to the MgO (001) surface is examined through the use of hydrogen interaction potentials that reflect the rotational state (*ortho* $J=1$) and orientation (m_J) of the adsorbed hydrogen molecules. This is in contrast to previous work[1] where instantaneous classical potentials were used and quantum effects added after the Monte Carlo simulations were performed. These previous simulations[1] showed a set of structures, *c*(4x2), *c*(4x2) and *c*(6x2), in agreement with HAS results,[2] where molecules adsorbed over cation sites were in the m_J=1 (helicoptering) state, but the value of m_J for molecules adsorbed above the bridge sites were unknown.The current work incorporates quantum effects prior to the running of the simulation and predicts that molecules adsorbed on bridge sites in the *c*(4x2) and *c*(6x2) structures will prefer the m_J=0 (cartwheeling) state. The surface thus uniquely selects the ground state quantum numbers of all of the adsorbed molecules.

1. J. N. Dawoud and D. B. Jack, App. Surf. Sci. **256** 1443-51 (2009).

2. J. G. Skofronick, J. P. Toennies, F. Traeger, and H. Weiss, Phys Rev B **67**,035413-27 (2003).

15 17:10 Saturday Saywell Hall Atrium

Development of an aptamer-based electrochemical biosensor for the detection of cancer marker MUC-1 **C Ho** <*cassieh@sfu.ca*> and **HZ Yu**[*$] <*hogan_yu@sfu.ca*>, Department of Chemistry, Simon Fraser University, 8888 University Drive, Burnaby, BC V5A1S6.

Mucin-1 (MUC-1) is an o-glycosylated human epithelial carcinoma-associated mucin protein. Underglycosylated MUC-1 in the bloodstream is an early hallmark of tumorigenesis in human adenocarcinomas. A DNA aptamer that targets a 20 amino acid repeating variable tandem repeat region (VTR) in MUC-1 has been previously selected by Ferreira et al. (Tumor Biol 2006; 27:2893011). We are developing an aptamer-based electrochemical sensor using methylene blue tagged anti-MUC-1 aptamer SS2.2. The aptamer is folded into its meta-stable hairpin structure then immobilized onto a gold electrode surface using thiol-gold linkages. The surface density of aptamers is determined using cyclic voltammetry and the binding affinity of the surface-bound aptamer-MUC1 complexes will be compared with that in solution (i.e., derived from gel electrophoresis binding assays). The detection specificity and sensitivity will be evaluated and compared with conventional ELISA kits.

16 17:10 Saturday Saywell Hall Atrium

Exploring Chemical Modification of Graphene **J. Bobak** <*jbobak@uvic.ca*>, **D.J. Collins** <*d-collins@shaw.ca*> and **D.W. Steuerman**[*$] <*dws@uvic.ca*>, Department of Chemistry, University of Victoria, Victoria, BC V8W 3V6; **K. Dumaisnil** <*kevindumaisnil@aol.fr*>, Department of Chemistry, Universty of Valenciennes and hainaut-Cambrésis, Valenciennes, France.

In decades sp2 hybridized carbon systems, such as fullerenes, carbon nanotubes and graphene, have emerged as candidate materials for active components in a variety of optical and electronic devices. Many of these systems hinge on the development of reliable methodologies for their chemical functionalization. We focus on two broadly defined modification approaches for graphene: noncovalent and covalent. Our functionalization schemes include the reduction of graphene to graphane, as well as strong supramolecular interactions from conjugated pi-systems. To this end, we have used optical and electron-beam lithography to fabricate single-layer graphene field effect transistors from mechanically exfoliated graphite. Electron transport characteristics are examined before and after chemical modification and Raman microscopy is further employed to spectroscopically probe the modified graphene. These efforts marks an important step towards the optimization of graphene-based devices for a variety of applications.

17 17:10 Saturday Saywell Hall Atrium

Energy and Conformation of Glycinate ($NH_2CH_2COO^-$) on Cu(110) **A Abd-El-Aziz** <*pelennor90@hotmail.com*> and **D B Jack***$ <*david.jack@ubc.ca*>, Department of Chemistry, University of British Columbia.

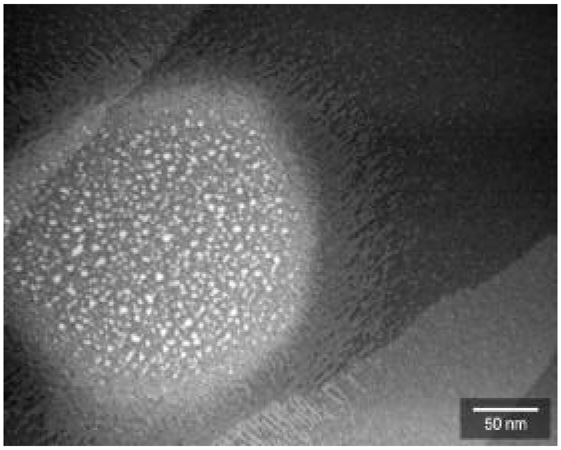
In order to better understand the self-assembly of amino acids on metal surfaces, electronic structure calculations (using Density Functional Theory within GAMESS) were performed for the chemisorption of a single glycinate ion on the (110) face of copper. The copper surface was modeled as a small crystalline patch consisting of 10 12 atoms that were fixed in position. The glycinate was placed on the surface in a variety of locations that represented the incremental motion of the molecular ion across the surface. The location of the ion was characterized by the position of either the nitrogen atom or the carboxylate carbon atom above the surface. The positions of the other atoms in the glycinate ion were allowed to relax into their optimal geometry (lowest energy) around the constrained atom and fixed copper atoms of the surface. By examining the energy as function of glycinate conformation and location on the surface, an estimate of the energy barrier for the movement of the molecule across the surface was obtained. The barrier height for diffusion is estimated to be ~8-10 kcal/mol. The binding energy to the copper surface was found to be 44.2 kcal/mol in agreement with previous calculations [1] and consistent with experimental measurements [1]. The energy barrier to changes in molecule-surface chirality was also examined.

1. Nyberg, M., Hasselström, J. Karis, O., Wassdahl, N., Weinelt, M., Nilsson, A., Pettersson, L. G. M. Journal of Chemical Physics **112**(12), 5420-8 (2000).

18 17:10 Saturday Saywell Hall Atrium

Nanostencil patterning of In and Sn on atomically clean Si(001) **N To** <*nelson.to@utoronto.ca*>, **S Dobrin** <*sdobrin@hotmail.com*> and **J Nogami***$ <*jun.nogami@utoronto.ca*>, Materials Science and Engineering, University of Toronto.

A self-aligning nanostencil mask is used to pattern circular features of tin and indium over an atomically clean Si(001) substrate. The shadow mask limits material to deposit only where the membrane is open, leaving adjacent clean surfaces for material to diffuse. STM is used to study the surface diffusion of these metals in UHV. The diffusion of tin is found to be relatively limited in comparison with indium, and remains so even at increasing coverage. Indium forms unstable 3D islands that dissolve over time and contribute to the spreading of a single layer thick film on the surrounding clean surface. The difference in behaviour between the two metals can be attributed to the difference in activation energy for diffusion of atoms on top of the first atomic layer of metal.



19 17:10 Saturday Saywell Hall Atrium

Electrochemically Controlled Interaction of Liposomes with a Lipid-like Layer **A Musgrove** <*musgrove@chem.ubc.ca*> and **D Bizzotto**[*$] <*bizzotto@chem.ubc.ca*>, AMPEL, Department of Chemistry, University of British Columbia.

The adsorption and fusion of liposomes to form lipid layers on solid surfaces is important for advanced modeling of cell membranes, biosensors and drug screening. Such bilayer formation occurs through a bursting and spreading of liposomes over the solid surface, but the mechanism of this process is not fully understood. The ability to predict and control formation of these layers is particularly important, as adsorption of liposomes may lead to non-uniform surfaces. To this end, electrochemical (capacitance) studies of liposomes interacting with a Au(111) electrode are described.

In order to provide a greater degree of control over liposome adsorption, as well as to facilitate future in-situ imaging, liposomes were studied both adsorbing directly onto the Au(111) and onto the electrode modified with an octadecanol layer. In this case, the gold surface is first coated with a lipid-like layer (octadecanol), a solid adsorbed layer that can undergo reversible potential induced phase transitions defect formation followed by desorption at negative potentials. Capacitance measurements were used to study the adsorption and fusion of liposomes into the pores or defects in the adsorbed lipid layer. Observed changes in capacitance suggest that liposomes, under potential control, may be fused into the adsorbed lipid layer as predicted by the model.

20 17:10 Saturday Saywell Hall Atrium

Large Scale Crystallinity in Polythiophene-Based Langmuir-Blodgett Films: Imaging Conducting Polymers at the Molecular Level **G.W. Leach**[*$] <*gleach@sfu.ca*>, **J. Mattu**[a,b] <*jmattu@sfu.ca*> and **J. Han** <*josephh@sfu.ca*>, [a]Department of Chemistry, Laboratory for Advanced Spectroscopy and Imaging Research and 4D LABS,, Simon Fraser University, Burnaby, BC; [b]Current Address: Health Canada, Ottawa, On.

We describe the fabrication and characterization of highly ordered ultrathin films of poly(3-(11-(2-tetrahydropyranyloxy)undecyl)thiophene) (PTHPUDT) via the Langmuir-Blodgett method and demonstrate large scale molecular level ordering in a complex poly(3-alkylthiophene)-based thin film. The films are made from the regioregular, amphiphilic polythiophene derivative PTHPUDT and afford kinetically stable, high optical quality films deposited layer-by-layer. X-ray diffraction studies confirm the deposition of a film with long range order normal to the surface, characterized by bilayer separations of ~30 Å. The films display in-plane anisotropy, associated with the preferential alignment of the polymer main chain in the dipping direction. Molecular resolution atomic force microscopy shows the presence of highly ordered crystalline domains within the plane, consistent with an ordered array of parallel, closed-packed, polythiophene chains. Polarized optical microscopy confirms the formation of large scale domains that display uniform optical retardation across macroscopic length scales. Oxidative doping of these films yields the conducting polymer and permits scanning tunneling microscopy imaging of the films. The doped films display a superstructure consistent with long range order within the two-dimensional polymer planes and the delocalized nature of bipolaron formation. The degree and nature of the ordering in these semi-crystalline films make them an ideal model system in which to elucidate the connection between morphology and physical property in complex conjugated polymers and to probe the fundamental characteristics of charge transport at organic electronic interfaces.

21 17:10 Saturday Saywell Hall Atrium

Investigating the fate of reductively desorbed molecules from self assembled monolayers

J.R. Casanova-Moreno <*jcmoreno@chem.ubc.ca*> and **D. Bizzotto**[*$] <*bizzotto@chem.ubc.ca*>, Chemistry Department, Rm D223 - 2036 Main Mall, Vancouver, British Columbia,, CANADA V6T 1Z1.

Reductive desorption of thiol self assembled (SAM) monolayers on gold is a common way to modify or regenerate functionalized surfaces. In this work we try to understand the factors that influence the fate of the electrochemically desorbed molecules through the coupling of potential control with fluorescence microscopy measurements. The system employed consists of Au microelectrodes (25 µm diameter) encased in a borosilicate tubing with an external diameter of approximately 350 µm. A SAM of a 10 carbon alkylthiol modified with the fluorophore Bodipy was formed by submerging the electrode for 20 min in a 1.2 mM solution of the thiol.

Since the desorbed molecules bear a negative charge we expected to be able to control the direction of their movement by placing the counter electrode in close proximity to the working electrode. However, although some of this effect was observed, most of the directionality was surprisingly dominated by a seemingly buoyant effect, in which most of the fluorescent molecules tend to go higher in solution. To prove this, we deliberately tilted the electrode in different angles, and the fluorescence followed accordingly.

These results suggest that the desorbed molecules must form some sort of aggregates big enough to be affected by the gravitational field. Future experiments with more polar SAMs will be performed to prove this theory.

22 17:10 Saturday Saywell Hall Atrium

Photothermal Treatment of LCAM Cancer Cells Using Polyethylene Glycol-Modified Gold Nanorods

I. C. Pekcevik[$] <*ikiplang@sfu.ca*>, **J. Zhou** <*jhz@sfu.ca*>, **M.C.P. Wang** <*mwangl@sfu.ca*> and **B.D. Gates** <*bgates@sfu.ca*>, Simon Fraser University; **B. Oberleitner** <*birgit.oberleitner@curie.fr*> and **V. Semetey**[*] <*vincent.semetry@curie.fr*>, Institut Curie.

Simon Fraser University, Department of Chemistry and 4D LABS, 8888 University Drive, Burnaby, BC V5A 1S6 Canada

In this study, gold nanorods (Au NRs) with a biocompatible surface coating were prepared for the targeted destruction of LCAM cancer cells. The gold nanorods were modified with polyethylene glycol (PEG) coatings for biocompatibility and stabilization against aggregation. The nanorods were also decorated with fluorescein isothiocyanate (FITC) dye as a fluorescent label for tracking the particles. In addition to their use as imaging contrast agents, the nanorods were used for photothermal treatment of the LCAM cells. The stability of the PEG coated nanorods upon irradiation with a femto-second laser was investigated for various power densities. During this study, changes to the surface plasmon resonances (SPR) of these Au NRs were monitored by UV-Vis spectroscopy. Relatively low laser powers densities did not produce a shift in the SPR of the Au NRs, suggesting these particles were stable during the photothermal process. The LCAM cells were incubated with different concentrations of Au NRs to determine the minimal concentration of rods that was not toxic to cells and yet was also effective in killing the cells through photothermal treatment. Control experiments were performed by laser irradiation of cells without the presence of Au NRs. The cells incubated with Au NRs were effectively killed by the photothermal process (>90% cell death) while those cells receiving laser irradiation without the addition of nanorods remained viable. In contrast, at lower concentrations of Au NRs less LCAM cells died as a result of the photothermal treatment.

23 17:10 Saturday Saywell Hall Atrium

Effect of Buffer Composition and Solution Temperature on the Stability of Gold Nanoparticles with Modified Surface Chemistries **M. Mahmoudi** <*msmahmou@sfu.ca*>, **I. Pekcevik**[*] <*ikiplang@sfu.ca*>, **M. Paul** <*mpaul@sfu.ca*> and **B. Gates**[$] <*bgates@sfu.ca*>, Simon Fraser University, Department of Chemistry and 4D LABS, , 8888 University Drive, Burnaby, BC V5A 1S6 Canada.

Understanding the properties of gold nanoparticles is essential before they can be reproducibly used in applications and processes that require long-term stability, such as in vivo delivery and release of therapeutics to specific biological targets. Monitoring the stability of these nanoparticles in various physiological solutions (e.g., physiological buffers) is an efficient approach to predicting the behavior of these nanoparticles within a cellular environment. Solution-phase synthesized gold nanoparticles were modified with 16-mercaptohexadecanoic acid (MHDA), and sometimes with other surfactants such as Tween 20 that has previously been demonstrated to assist in particle stabilization. These surface coatings increase the stability of gold nanoparticles against agglomeration and/or aggregation due to van der Waals stabilization of the surfactants attached to the gold and the electrostatic interactions of the coating with the solution. Quality of the self-assembled monolayers of alkanethiolates on the gold nanoparticles was investigated by varying the conditions of these solutions. Some of these test solutions included analyzing the long-term stability of these particles in either a phosphate buffer or a tris borate ethylenediaminetetraacetic acid (TBE) buffer. The functionalized nanoparticles were also incubated for several weeks at different temperatures (e.g., room temperature to above 37 °C, physiological temperatures). Minimal instability of the particles was observed over periods from a few hours to a few days. Some changes to the suspensions of particles were only observed after relatively long periods of analyses (e.g., a few weeks). The intent of these studies was to determine the long-term stability of the particles for storage and transport, as well as applications that require contact with biological systems. The stability of the decorated nanoparticles was assessed for a wide range of surface and solution conditions

24 17:10 Saturday Saywell Hall Atrium

Development of Metastable Atom De-excitation Spectroscopy for the Study of Physical and Electronic Surface Structure **ST Read** <*sread@uoguelph.ca*>, **A Lyagusha** <*alyagush@uoguelph.ca*> and **PA Rowntree**[*$] <*rowntree@uoguelph.ca*>, Department of Chemistry, University of Guelph, Guelph ON N1G 2W1.

An important challenge of surface science is determining the structure of the interfacial surface, without the addition of competing information from the sub-surface. This is particularly true in the case of weakly bound systems such as physisorbed adsorbates where sub-monolayer coverages and sensitivity to low-energy pertubations must be considered.

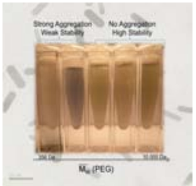
We have developed a Metastable Atom De-excitation Spectroscopy (MADS) probe in our lab in order to study these challenging systems. MADS relies on neutral Helium atoms in a long-lived, high-internal energy electronically excited state produced in a high voltage discharge. The interaction of the excited atom with a surface results in the ejection of an electron from the surface. The resulting kinetic energy spectrum of the ejected electrons provides similar information to a UPS analysis. Due to the low kinetic energy of the atomic probe the ejected electrons are sourced exclusively from exposed surface valence bands/orbitals resulting in information about the surface which is both distinct from and complementary to that obtained from UPS.

The operating conditions of the Helium discharge source which produces He* and He(I) UV have been optimized to maximize beam flux, and the time-of-flight profile of the beam and He* velocity distribution have been determined. Application of the technique to the study of weakly-adsorbed systems such as $Fe(CO)_5$ will also be discussed.

25 17:10 Saturday Saywell Hall Atrium

Optimizing the formation of biocompatible gold nanorods (GNR) to target cancerous cells: functionalization, stabilization and purification

B. Oberleitner[*] <*birgit.oberleitner@curie.fr*>, **N. Bogliotti** <*nicolas.bogliotti@curie.fr*>, **F. Schmidt**[a,b] <*frederic.schmidt@curie.fr*>, **J.-C. Florent**[a,b] <*jean-claude.Florent@curie.fr*> and **V. Semetey**[$a,c] <*vincent.semetey@curie.fr*>, [a]Institut Curie, Centre de Recherche, Paris, F-75248 France; [b]CNRS, UMR176, Paris, F-75248 France; **L. Johannes** <*ludger.johannes@curie.fr*>, CNRS, UMR144, Paris, F-75248 France; [c]CNRS, UMR168, Paris, F-75248 France.

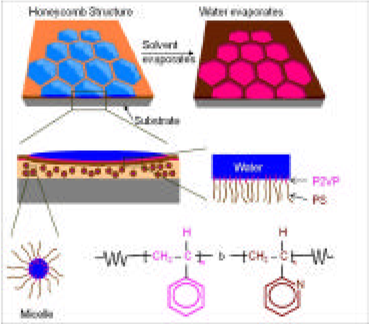


Gold nanorods (GNR) are known to provide unique tunable optical properties due to their absorption band in the UV-Visible region and are therefore promising tools for material, biological and biomedical applications. Stabilized by Cetyltrimethylammonium bromide (CTAB) surfactant, these rodlike nanoparticles show cytotoxicity, thus a direct application in biological tissue is problematic.
Therefore, surface functionalization is a key step during gold nanorods preparation, since it should provide stability, solubility and physico-chemical properties compatible with a given application. Once functionalized with polymeric molecules, however, this behaviour changes, leading to biocompatible nano-antennas.
To date only little is known about the influence of GNR coating on their optical properties, stability and purification. We have performed a systematic study on the influence of functionalization conditions and coating agents on the morphology and optical properties of PEG (Polyethylene glycol)-ylated gold nanorods.
In the aim of creating optical tools for in vivo applications, enabling active targeted cancer therapy, we sucessfully modified the surface of the nanofabricants. We linked RGD as well as Shigatoxin B, molecules which are known to specifically bind to tumor cells, onto the GNR surface.

26 17:10 Saturday Saywell Hall Atrium

Large-Area and Uniform Honeycomb Structured Film Fabricated by PS-b-P2VP Block Copolymer

J. Kim <*jiseokk@sfu.ca*>, **B. Lew** <*blew@sfu.ca*> and **W. S. Kim**[*$] <*woosook@sfu.ca*>, Mechatronics Systems Engineering, School of Engineering Science, Simon Fraser University, Surrey, B.C. Canada V3T 0A3.



Large-area (10mm^2) and uniform micron honeycomb patterns were fabricated by self-assembly of an amphiphilic block copolymer polystyrene-b-poly(2-vinylpyridihne), PS-b-P2VP, for which breath figures method was applied at a high relative humidity over 90%. During the breath figures, water droplets form pores on the block copolymer film, and hydrophilic part, P2VP, attach to the glass substrate and goes into water droplets while hydrophobic part, PS, remains inside the film. Size and density of pores and wall thickness between pores on the honeycomb patterns have shown dependence on concentration of the block copolymer. Pore size increased until the block copolymer solution reached a critical concentration and, afterward decreased. And pore density, as expected, showed a reverse result while wall thickness between pores showed a positive correlation with concentration. These results could be explained by the correlation between water droplet sinking and the viscosity of the block copolymer solution. Additionally, film transmittance was investigated because visible light scattering is related to film microstructures. As pore size increased, transmittance for visible light also increased. The transmittance of the block copolymer film could be manipulated by changing the polymer concentration which results in changing pore size of the polymer honeycomb pattern. This large-area and uniform honeycomb structure can serve as a scaffold whose functional flexibility is limited only by what is appendable to P2VP.

27 17:10 Saturday Saywell Hall Atrium

Shape Controlled Electrodeposited Metal Particles on Gold Thin Film Electrodes

Y.Y. Han[$] <*josephh@sfu.ca*>, **C. McCague** and **G.W. Leach**[*], Department of Chemistry, Laboratory for Advanced Spectroscopy and Imaging Research and 4D LABS, Simon Fraser University.

The effect of additives on metal films and particles electrodeposited on gold thin film electrodes is investigated. The results show that additives can change the electrochemical process of copper and gold deposition, so as to form differently shaped metal particles. It is found that the blocking effect increases the reduction potential and decreases the reduction currents, giving rise to electrodeposited metal structures with preferential shapes. Atomic force microscopy (AFM), scanning electron microscopy (SEM) and x-ray diffraction (XRD) results show that organic additives have dramatic effects on copper deposits. The shape and size of copper particles can be controlled by the additives, and morphologies of copper deposits are determined by the types of additives. In situ scanning tunnelling microscopy (STM) demonstrates that the growth kinetics in the presence of additives is different from those without additives, and that the resulting crystallites adopt different structures. The use of additives has been extended to electrodeposited structures patterned by colloidal lithography to make shape-controlled micro-arrays for plasmonic applications.

---

28 17:10 Saturday Saywell Hall Atrium

Photo-curable Silver Nanoparticle Ink for Direct Stamping of Thick Micro-Patterning

L.H. Hsieh <*lhsieh@sfu.ca*>, **Wong** <*clw9@sfu.ca*> and **W.S. Kim**[*] <*woosoo_kim@sfu.ca*>, Mechatronic Systems Engineering, School of Engineering Science, SFU.

Functional materials like nanosized silver particles (Ag NPs) have been attracting more and more attention due to their low annealing temperatures and substrate compatibility. They are suitable for a number of different patterning techniques including, direct stamping, ink jet printing and photolithography enabling them to be a low cost, high performance, high volume conductive ink. In addition, silver nanoparticle inks have been synthesized and used various applications in which a conductive, printed material is needed. A few applications include their use as electrodes in thin film transistor devices (TFTs), as printed conductive lines for a 3D antenna and as a 2D conductive transparent array. The versatility of silver nanoparticles provides an alternative compare with conventional cost-ineffective fabrication methods and other expensive materials, such as gold.

In this presentation, a photo-sensitive component, epoxy, was introduced to form photo-curable Ag NPs ink. Photocurable Ag NPs ink was synthesized by the reduction of silver acetate with phenylhydrazine and hexadecylamine allowing for crosslinking of epoxy to the surface of the Ag NPs. By introducing the photosensitive epoxy polymer during the synthesis, we combine the properties of silver and of the photoresist alike. This hybrid material will have both the UV curing aspect brought by the epoxy as well as the conductivity and patterns ability of the Ag NPs ink. Upon UV exposure, the silver nanoparticles can be formed in continuous form to make conductive electrodes. In addition, UV curing allows for better mechanical and chemical resistance inducing the Ag NPs adhere to a particular substrate well.

29 17:10 Saturday Saywell Hall Atrium

A USB-powered, stand-alone electrochemical biosensor prototype for point-of-care medical diagnosis **Yiting Tang**, **Cassie Ho** and **Hogan Yu**[*], Department of Chemistry, Simon Fraser University, Burnaby, BC V5A 1S6, Canada; **Carlyn Loncaric**[$] and **Ash Parameswaran**, School of Engineering Science, Simon Fraser University, Burnaby, BC V5A 1S6, Canada.

Portable biosensors have revolutionized the world of medicine by enabling on-site diagnostics, and providing real-time results at a lower cost for health organizations and patients. In this work, we have developed a portable, USB powered biosensor prototype that performs a simple electrochemical approach for the detection of an omnipresent protein lysozyme using aptamer-modified electrodes. Cyclic voltammetry (CV) analysis is performed within miniaturized cells fabricated on a standard 3×1" glass slide. The gold working electrode was prepared using photolithographic techniques. Anti-lysozyme DNA aptamers were immobilized on gold electrode surfaces by means of self assembly. Redox cations $[Ru(NH_3)_6]^{3+}$ were bound to the surface via electrostatic interaction with the DNA phosphate backbone; the CV response of surface-bound $[Ru(NH_3)_6]^{3+}$ decreased upon incubation of the electrode with a solution containing lysozyme. The magnitude of decrease in the reduction signal was used as a quantitative measure of the protein concentration.[1] The results of tests using the portable potentiostat and miniaturized cell are comparable to those using a benchtop potentiostat with conventional cells.

[1] Cheng, A. K. H.; Ge, B.; Yu, H.-Z. *Anal. Chem.* **2007**, *79*, 5158-5164.

30 17:10 Saturday Saywell Hall Atrium

Fabrication of Platinum Nanoparticle Decorated Porous Niobium Oxide Catalyst Layers for Fuel Cell Applications **B Kinkead** <*bkinkead@sfu.ca*> and **BD Gates** <*bgates@sfu.ca*>, Department of Chemistry, Simon Fraser University, 8888 University Dr., Burnaby, BC, V5A 1S6.

The use of low temperature fuel cells in commercial applications is greatly restricted by the high cost and limited stability of the oxygen reduction reaction (ORR) catalyst layer. These layers are typically composed of Pt nanoparticles dispersed on a carbon black support; suffering from degradation via support oxidation, Pt dissolution, Pt oxidation and Pt aggregation. The fabrication of catalyst layers with enhanced stability under harsh fuel cell operating conditions is desirable to improve device lifetime and maximize the catalytic activity per mass Pt. Niobium oxide supports are being pursued because of their charge-transfer bonding interaction with Pt and ability to minimize Pt oxide formation, both of which can improve stability and catalytic efficiency. A template method is used to create the Pt decorated porous Nb oxide layers, allowing control over Pt particle size, Pt distribution, pore size and pore ordering. The layers are then characterized by X-ray spectroscopy and electron microscopy. This method for fabricating designer catalyst layers can enable comparison to theoretical analysis, optimization of water management and optimization of Pt activity.

31 09:00 Sunday Saywell Hall 10081

Atmospheric Heterogeneous Photochemistry **D.J. Donaldson**[*$] <*jdonalds@chem.utoronto.ca*>, Department of Chemistry, University of Toronto.

The study of atmospheric heterogeneous chemical processes has almost exclusively been carried out in the dark. Very recently, an important role of the substrate in promoting photochemical reactions at atmospheric interfaces has been elucidated. I will describe some of our recent results on photo-enhanced and photochemical atmospheric processes on aqueous, ice and mineral dust surfaces

32 09:50 Sunday Saywell Hall 10081

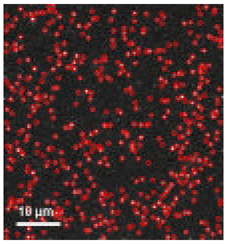
Combining nonlinear vibrational spectroscopy, electronic structure calculations, and molecular simulations to characterize the structure of molecules adsorbed at solid-liquid interfaces **DK Hore**[*$] <*dkhore@uvic.ca*>, **SA Hall**, **KC Jena**, **PA Covert** and **S Roy**, Department of Chemistry,, University of Victoria,, Victoria, BC, V8W 3V6, Canada.

Understanding the orientation and conformation of biomolecules adsorbed onto solid surfaces is an important aspect in designing biocompatible materials, in the immobilization of enzymes for biosensors, and in chromatography. Experiments and simulations have provided evidence that the surface-adsorbed structure of biomolecules may be very different from that in solution, particularly when the surface is hydrophobic. But what is the adsorbed structure? The primary challenge in answering this question is to gather detailed structural information with enough specificity so as to exclude contributions from adjacent bulk phases. Furthermore, the unique surface structure is due to three interdependent phenomena: the nature of the biomolecule, nature of the substrate surface, and the concerted arrangement of the solvent molecules. The central aim of our group is to provide a complete structural description of the adsorbed state by monitoring each of these aspects. We use Stokes vector and Mueller matrix ellipsometry to characterize the bulk phases and to monitor the kinetics of the adsorption process. Visible-infrared sum-frequency generation spectroscopy is used to characterize the adsorbed molecules and solvent structure. Finally, we compare our experimental results with those from molecular dynamics simulations to gain additional insight into fine structural features.

33 10:50 Sunday Saywell Hall 10081

Imaging the Kinetics of Single Molecules at Lipid Membranes and Charged Surfaces

J. M. Harris <*harrisj@chem.utah.edu*>, **C. B. Fox**, **G. A. Myers** and **E. M. Peterson**, Univ. of Utah.

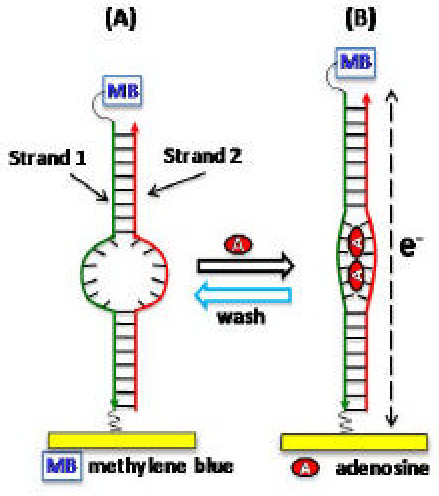


Quantitative imaging of fluorescent molecules at surfaces is a powerful method to characterize is equilibria and dynamics of interfacial processes. Internal-reflection confines laser excitation to an interface, allowing imaging of molecules at solid surfaces in contact with liquids. We have applied this method to count populations of membrane-active peptides interacting with lipid bilayers on glass surfaces. Fluorescence imaging can report membrane-binding equilibrium constants through counting of individual, bound peptides in the membrane versus the solution concentration. The membrane residence times of individual molecules can also be determined, and the rates of unbinding calculated from a histogram of residence times. We have used this method to characterize the lipid membrane affinity of glucagon-like peptide-1 (GLP-1), a 30-residue peptide involved in glycemic control. Two rates of dissociation were observed, indicating strongly and weakly bound states of the peptide. The rate of membrane association is much slower than diffusion-controlled, indicating a significant kinetic barrier to membrane association. The data were interpreted using a two-state adsorption and binding model, where microscopic rates connecting adsorbed and bound states of the peptide could be resolved. Another important area of interfacial chemistry that can be investigated by single-molecule imaging is the behavior of polymer electrolytes near charged surfaces. We have developed total-internal reflection fluorescence imaging of polyelectrolytes near electrically polarized surfaces using indium-tin-oxide coated glass coverslips, whose surface potential can be controlled relative to the bulk solution. Populations of fluorescently labeled DNA molecules in the double-layer are counted as they respond to the applied potential, while their lateral diffusion rates and residence times are measured by tracking their motions.

34 11:40 Sunday Saywell Hall 10081

Surface-Immobilized DNA Aptamer Constructs as Electronic Biosensing and Switching Nano-devices

B. Chakraborty <*bca35@sfu.ca*> and **H-Z. Yu**[$] <*hogan_yu@sfu.ca*>, Department of Chemistry, 4D LABS, Simon Fraser University; **D. Sen**[*] <*sen@sfu.ca*>, Department of Molecular Biology and Biochemistry, Simon Fraser University.

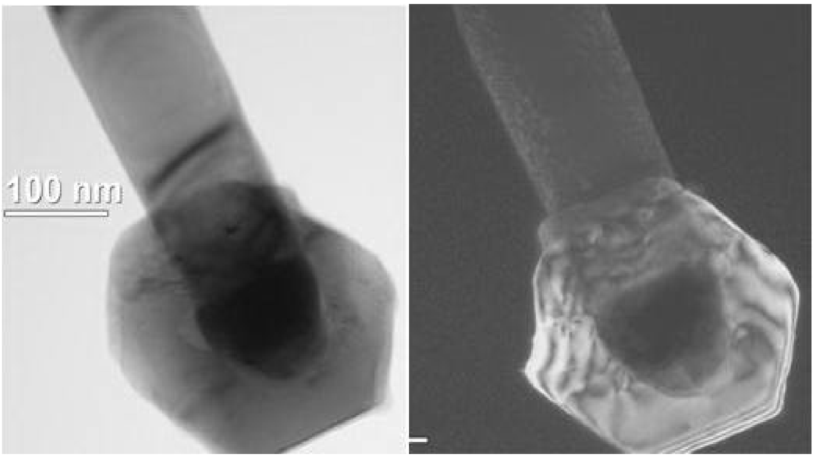


The integrated-ligand deoxyribosensor (ILD) is a unique class of DNA aptamer-based electronic biosensors, in which a relatively unstructured aptamer loop is incorporated in the middle of an otherwise complementary, and electrically conductive, DNA duplex (Fahlman, R.P.; Sen, D. J. Am. Chem. Soc. 2002, 124, 4610). Herein, we use direct electrochemical measurements performed when the ILD is immobilized on a gold surface; to show that a small-molecule ligand, adenosine, can be used to repair a 12-nucleotide discontinuity (an anti-adenosine aptamer stem) within the DNA conduction path. Such a ligand-responsive device may be of use not only in nano-electronic circuitry but also constitutes a sensitive surface immobilized biosensor for adenosine. The sensitivity of the immobilized ILD on gold surface detected through electrochemistry is an order or magnitude greater than that in solution measured through gel electrophoresis. The ready reversibility of such an immobilized device on gold surface ensures its re-usability as a biosensor, and offers the potential as a ligand-gated switch in nano-electronics.

35 13:30 Sunday Saywell Hall 10081

Electrodeposition of metal on GaAs nanowires

C Liu <*cla95@sfu.ca*>, **O Einabad**, **S Watkins** and **K Kavanagh**, Department of Physics, Simon Fraser University, Burnaby, BC V5A 1S6.



Copper (Cu) electrical contacts to freestanding gallium arsenide (GaAs) nanowires have been fabricated via electrodeposition. The nanowires are zincblende (111) oriented grown epitaxially on n-type Si-doped GaAs(111)B substrates by gold-catalyzed Vapor Liquid Solid (VLS) growth in a metal organic vapour phase epitaxy (MOVPE) reactor.The epitaxial electrodeposition process, based on previous work with bulk GaAs substrates, consists of a substrate oxide pre-etch in dilute ammonium hydroxide carried out prior to galvanostatic electrodeposition in a pure Cu sulphate aqueous electrolyte at 20-60^{0}C.

For low-doped GaAs nanowires, we find that Cu or Fe has a preference for growth on the gold catalyst avoiding the sidewalls. After removing gold, both metals still prefer to grow only on top of the nanowire, which has the largest potential field. For low-resistant highly C-doped GaAs nanowires, we find Cu growth along the sidewalls as well as on the gold catalyst, which is due to the high conductivity of the nanowire.

36 14:00 Sunday Saywell Hall 10081

Modifying the Surface Chemistry of Selenium Nanowires via UV-Initiated Reaction

Michael C Wang <*mwangl@sfu.ca*> and **Byron D. Gates**[*$] <*bgates@sfu.ca*>, Simon Fraser University, Chemistry Department, 8888 University Drive V5A 1S6.

Our knowledge of the surface chemistry of selenium nanowires (Se-NWs) has provided us with essential information that assisted in their processing and incorporation into devices. As the key component in electrical devices, selenium has a wide variety of applications, such as non-linear optoelectronics and photon detectors. The performance characteristics as well as the longevity of these devices, depend on the material's ability to resist oxidation. In our prior investigation, we have observed that Se-NWs oxidize slowly under ambient condition. Therefore, it is crucial to alter Se-NWs' surface chemistry with materials that will resist or slow down the oxidation process. An approach that we have developed is to covalently link small molecules of interest to the surfaces of Se-NWs via ultraviolet light initiated reaction. A range of surface sensitive spectroscopy techniques (Transmission Electron Microscopy, Energy Dispersive X-Ray Spectroscopy, X-Ray Photon Spectroscopy, and Secondary Ion Mass Spectrometry) are used to determine the success of these surface chemistry modifications.

37 14:30 Sunday Saywell Hall 10081

Surface effects in chiral adsorption **T. Popa** <*tatianap@uvic.ca*> and **I. Paci** <*ipaci@uvic.ca*>, Department of Chemistry, University of Victoria,, Victoria, BC,, Canada.

Chiral separation is an essential problem especially for pharmaceutical industries, where as products of synthetic chemistry, chiral drugs are often manufactured and used as racemates. While one enantiomer may exhibit the desired activity, the other may be inactive, counteractive or even toxic. Thus the interest in developing new enantioselective processes is continuously growing. We have been interested in examining how self-assembly on a solid substrate may be used to promote chiral resolution. We studied the chiral self-assembly of several model molecules on a substrate using Parallel Tempering Monte Carlo. Well segregated, enantioselected micellar structures formed on the surface by some of our model molecules. Adsorbed patterns and geometries were largely unaffected by surface attraction or layouts when low Miller index apolar surfaces were used, although several types of commensuration effects were observed when the atom size of the substrate was varied. A more complex dependence on surface geometry was observed on higher Miller index chiral surfaces. The results of these studies of surface effects in chiral self-assembly will hopefully serve a role in understanding how one can enhance enantiomeric excess in chiral mixtures by the choice of substrate.

38 15:00 Sunday Saywell Hall 10081

Recrystallization of Electrodeposited Copper Thin Films **N Alshwawreh**[*$] <*nidal@interchange.ubc.ca*>, **M Militzer** <*matthias.militzer@ubc.ca*> and **D Bizzotto** <*bizzotto@chem.ubc.ca*>, Advanced Materials and Process Engineering Laboratory, The University of British Columbia, Vancouver, BC, Canada; **J Kuo** <*jckuo@mail.ncku.edu.tw*>, Department of Materials Science and Engineering, National Cheng-Kung University, Tainan, Taiwan, ROC.

Electrodeposited copper thin films undergo a microstructure evolution process at room temperature known as self-annealing. In few hours to several days following the deposition, the average grain size increases from less than 200 nm to several micrometers. Self-annealing is believed to be driven by the stored energy in the form of dislocations and the process can be described as recrystallization. In this work, the effect of deposition current density (5-40 mA/cm^2) and film thickness (0.5-2 μm) on the self-annealing rate was studied. The film microstructure was characterized by resistivity and in-situ electron backscatter diffraction (EBSD). The resistivity measurements indicated that, following an incubation period, the resistivity of the film is decreaed by about 20%. The recrystallization time is dependent on the deposition rate and the film thickness. In-situ EBSD confirmed that the change in resistivity is accompanied by a microstructure evolution at the film surface. The recrystallized grains appear to have a high image quality, high twin density and low local orientation spread. By comparing the self-annealing rates from both techniques (i.e. resistivity and EBSD), the recrystallization process seems to start near the film-substrate interface and then proceed to the film surface.

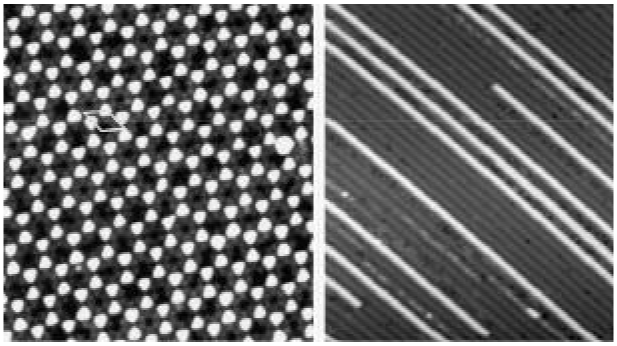
39 16:00 Sunday Saywell Hall 10081

Simulation of water vibrational response next to solid surfaces **S Roy** <*saroy20@uvic.ca*>, **HM Roth** and **DK Hore***$ <*dkhore@uvic.ca*>, Department of Chemistry,, University of Victoria,, Victoria, BC, Canada, V8W 3V6.

As one of the most important and common molecules on Earth, many properties of water have been extensively studied, including its interaction with material surfaces. Since experiments that probe water-surface interactions with high selectivity have been relatively late to arrive on the scene, molecular simulations have provided much insight into interfacial structure. However, over the last decade, one experimental technique, vibrationally-resonant sum frequency generation (SFG) spectroscopy has been recognized as capable of providing a sensitive measure of interfacial water structure. Studies of water next to several hydrophobic and hydrophilic surfaces reveal drastically different spectral profiles. Although the SFG spectra are feature-rich, the microscopic origins of these features is still not well understood. Generating SFG spectra from molecular simulations can promote a better understanding of the spectra, allowing a direct comparison of local water structure and spectral intensities. We will describe the water structure and resulting SFG spectra at solid hydrophobic and hydrophilic surfaces, and make comparisons with what is known at the vapour-water interface.

40 16:30 Sunday Saywell Hall 10081

Using a surface template to control the width of rare earth silicide nanowires on the Si(001) surface **Y Cui** <*yan.cui@utoronto.ca*> and **J Nogami***$ <*jun.nogami@utoronto.ca*>, Materials Science and Engineering, University of Toronto.



Many low dimensional structures arise from self-assembly when depositing metals on silicon surfaces, including both quantum dots and quantum wires. The properties of these structures can depend critically on their dimensions. One class of these objects are rare earth silicide nanowires that grow on Si(001). In this presentation the control of nanowire width will be discussed. For quantum dots on the Si(111) surface, the native 7×7 reconstruction has beenused as a template to create lattices of clusters with a very narrow size distribution.[1] However, no similar templating effect has beenreported for the growth of nanostructures on Si(001). We use a dysprosium induced Si(001) 2×7 surface reconstruction to narrow the width distribution of Dy silicide nanowires. These results represent part of the development of nanowire growth techniques towards their eventual application in nanometer scale devices.

[1]Ye-LiangWang et al Journal of Nanomaterials, Volume 2008, Article ID 874213, (2008)

41 17:00 Sunday Saywell Hall 10081

Electrooxidation of Carbon Monoxide on Palladium **R L Sacci**[$] <*rsacci@uvic.ca*> and **D A Harrington**[*] <*dharr@uvic.ca*>, University of Victoria, , Department of Chemistry,, P.O. Box 3065 , Victoria, BC V8W 3V6 Canada.

There are few studies on carbon monoxide electrooxidation on palladium surfaces and fewer involving mass transport effects. These systems are of interest since CO poisoning in fuel cells is a major concern: oxidation of small organics is thought to produce CO on the catalytic surface. Herein we study the oxidation of CO in CO-saturated sulfuric acid at a Pd rotating disk electrode. We incorporate standard potentiostatic and hydrodynamic methods along with impedance measurements. We pay special attention to the changing double layer capacitance due to adsorbate concentration and potential sweep rate.

There have been few detailed studies on how CO adsorption affects the double layer capacitance or on the kinetics of CO oxidation on Pd / Pd-oxide surfaces. We show that the coverage of CO drastically affects its oxidation not only in the double layer region but also during the oxidation of the palladium surface. We discuss the current response at the onset of CO oxidation within the framework of a nucleation-growth-collision mechanism involving competition between OH(ads) and CO(ads). Afterwards, we show how this may be combined with the hypothesis about active site to produce a consistent reaction scheme throughout the potential region of study. We also give discuss the negative Tafel slope in electrocatysis

42 17:30 Sunday Saywell Hall 10081

Behavior of Chemisorbed Azobenzene on Gold Surfaces: Computational Study at the Zero-density Limit **C. R. L. Chapman** <*chapmanc@uvic.ca*> and **I. Paci**[*] <*ipaci@uvic.ca*>, University of Victoria.

Azobenzene derivatives exhibit a well-known and well-studied cis-trans photoisomerism. As a result, they have been used in a number of important applications. On a gold surface, scanning tunneling microscopy studies of N-(2-mercaptoethyl)-4-phenylazobenzamide (azobenzene) have revealed similar behavior. Some controversy remains as to the nature of the two states, and the relationships between applied electric field, ionic states and molecular geometry have yet to be rigorously explored for chemisorbed azobenzene. In this presentation, challenges and outcomes of our DFT investigations of azobenzene chemisorbed on a Au(111) surface, at the zero-density limit, will be discussed.

43 09:10 Monday Saywell Hall 10081

X-ray Spectromicroscopy of Oriented and Strained Surfaces <u>**S.G. Urquhart**</u>*$ <*stephen.urquhart@usask.ca*>, Department of Chemistry, University of Saskatchewan.

Strain has an important effect on the electronic and mechanical properties of semiconductor thin films. In SiGe devices, strain can increase electron mobility, allowing faster devices to be realized. In silicon nitride and gallium nitride thin films, epitaxial strain can affect the mechanical stability of devices and thin films. We are developing a high spatial resolution strain metrology, based on the "strain" sensitivity of x-ray absorption spectroscopy (through x-ray linear dichroism spectroscopy) and the high spatial resolution of x-ray microscopy. This method has the potential to examine strain at lateral size scales down to ~10 nm, well below the diffraction limit for Raman microscopy.

My presentation will discuss the use of x-ray linear dichroism microscopy (XLDM) in the study of strain in semiconductor thin films and in the characterization of orientated organic nanomaterials prepared by epitaxial growth. I will also discuss the development of new surface-sensitive x-ray microscopy techniques at the Canadian Light Source.

---

44 10:00 Monday Saywell Hall 10081

Redox driven coherent incoherent structural transform of VO_X on TiO_2(110) <u>**C.-Y. Kim**</u>*$ <*Chang-Yong.Kim@lightsource.ca*>, Canadian Light Source; **J.W. Elam**, Argonne National Laboratory; **P.C. Stair** and **M.J. Bedzyk**, Northwestern University.

A redox induced structural transformation for 2 monolayers of vanadia on α-TiO_2(110) (rutile) was studied by in situ X-ray standing waves [1], resonant anomalous X-ray reflectivity, and ex situ X-ray photoelectron spectroscopy. The VO_X film was grown by atomic layer deposition. Oxidation and reduction were carried out by annealing in atmospheric O_2 and H_2, respectively.

We found that an epitaxial rutile VO_2 film was formed in the reduced phase with V4+ cations in lateral alignment with Ti lattice positions. Oxidation was found to produce V5+ cations uncorrelated to the substrate lattice in the oxidized phase. The redox induced structural and oxidation state transformation proved reversible and involved the entire film; not just the surface layer.

[1] C.-Y. Kim, J.W. Elam, P.C. Stair, M.J. Bedzyk, J. Phys. Chem. C114, 19723 (2010).

45 11:00 Monday Saywell Hall 10081

Effect of precursor chemistry on the growth of III-V semiconductor nanowires O Salehzadeh and **S P Watkins** <*simonw@sfu.ca*>, Department of Physics, Simon Fraser University.

Metalorganic vapour phase epitaxy (MOVPE) is a key technology for the growth of III-V nanowires (NW) by the vapour liquid-solid (VLS) mechanism. The ability to grow axial and core shell heterostructures is an important requirement for NW device applications. Most prior work on GaAs NW growth using the vapour-liquid-solid (VLS) mechanism has involved the growth precursor trimethylgallium (TMGa) in conjunction with an arsenic precursor such as arsine or tertiarybutylarsine (TBAs). In this work we compare the growth of GaAs NWs grown using the ethyl-based precursor triethylgallium (TEGa) vs. TMGa over the temperature range 360-480°C using gold nanoparticles to catalyze the VLS growth.

TEGa decomposes at approximately 100C lower than TMGa based on the measurement of growth rates for planar films on (100) GaAs substrates. NWs grown with TEGa are highly tapered due to the fact that planar growth on the substrate and nanowire sidewalls competes with the VLS mechanism for incoming Ga flux. As a result, as wires increase in length, the sidewall portion of the wire grown at earlier times receives a larger Ga flux. In contrast, TMGa decomposes very weakly below 450°C in the absence of Au catalyst. The Au catalyst permits the growth of non-tapered GaAs NWs using TMGa even at temperatures as low as 370°C, where the planar growth rate on GaAs is essentially zero. We show that this difference in surface chemistry can be used to create either axial or core/shell InAs/GaAs heterojunction nanowires, depending on the precursors employed. We have also found that the use of carbon halogen dopant sources such as CBr_4 can result in similar dramatic effects on wire morphology due to suppression of planar growth by halogen species. Applications to the growth of n-core/p-shell structures for photovoltaic devices will be briefly discussed.

46 11:30 Monday Saywell Hall 10081

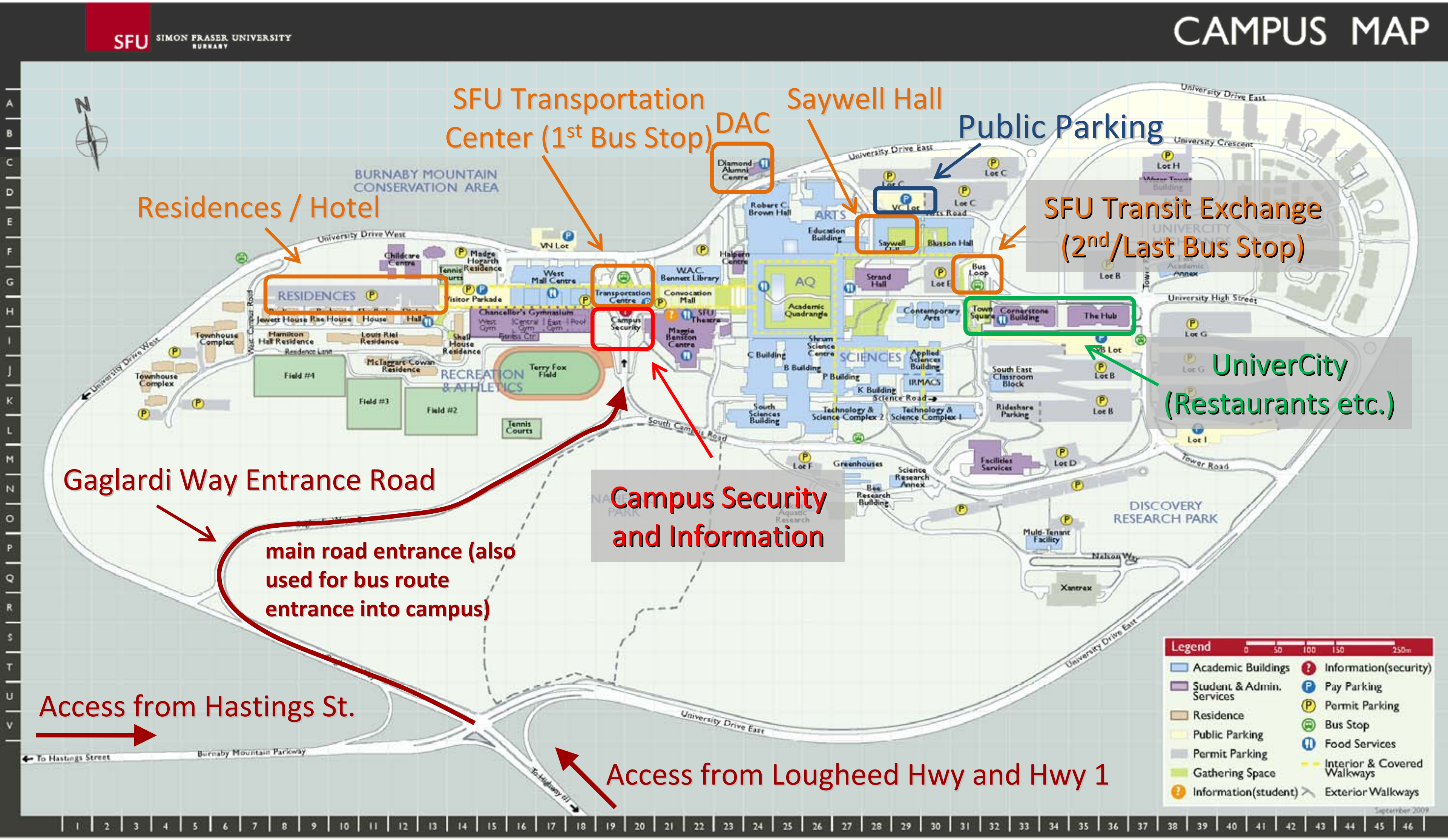
On-command photochemistry using upconverting nanoparticles J. C. Boyer, **C. J. Carling**, **B. D. Gates** and **N. R. Branda**[*$], 4D Labs, Simon Fraser University, 8888 University Drive , Burnaby, BC , Canada V5A 1S6.

The use of dithienylethene (DTE) photoswitches to achieve control of physical and chemical molecular properties has been well documented in recent years. Though the versatility of these photoswitches has been effectively demonstrated, the ring-closing and ring-opening reactions still require the need for ultraviolet (UV) and visible light, respectively. Here we show that is possible to use near-infrared (NIR) light to toggle two different DTE photoswitches back and forth between their isomers even though the chromophores do not significantly absorb this type of light. These photoreactions are achieved via a "remote control" process using hexagonal-phase lanthanide-doped NaYF4 upconverting nanoparticles (UCNPs) that absorb 980 nm light and convert it to UV and visible wavelengths through mulitphoton upconversion mechanisms. These upconversion emissions can then be utilized to mediate the photochemical reactions offering alternative means to potentially achieve 3D-data storage, drug delivery, and photolithography. Through the synthesis of core/shell/shell UCNPs doped with two different emissive lanthanide ions we are capable of triggering the ring-closing or ring-opening reactions by simply dialing up or down the power of the 980 nm excitation beam. It is shown that the efficiency of the photoreactions is highly dependent on the choice of the DTE switch and UCNP.

INDEX of Authors

The name of the author is followed by the abstract number. Presenting authors are shown in bold text.

CAMPUS MAP


SFU SIMON FRASER UNIVERSITY BURNABY
Residences / Hotel
SFU Transportation Center (1st Bus Stop)
DAC
Saywell Hall
Public Parking
SFU Transit Exchange (2nd/Last Bus Stop)
UniverCity (Restaurants etc.)
Campus Security and Information
Gaglardi Way Entrance Road
main road entrance (also used for bus route entrance into campus)
Access from Hastings St.
Access from Lougheed Hwy and Hwy 1
BURNABY MOUNTAIN CONSERVATION AREA
RESIDENCES
ARTS
AQ
Academic Quadrangle
SCIENCES
RECREATION & ATHLETICS
DISCOVERY RESEARCH PARK
W.A.C. Bennett Library
Convocation Mall
Transportation Centre
Campus Security
Diamond Alumni Centre
Robert C. Brown Hall
Education Building
Saywell Hall
Blusson Hall
Strand Hall
Bus Loop
Town Square
Cornerstone Building
The Hub
Terry Fox Field
Tennis Courts
Field #2
Field #3
Field #4
Chancellor's Gymnasium
West Mall Centre
Maggie Benston Centre
SFU Theatre
University Drive East
University Drive West
University High Street
Tower Road
South Campus Road
Nelson Way
Burnaby Mountain Parkway
To Hastings Street
To Highway #1
Legend
Academic Buildings
Student & Admin. Services
Residence
Public Parking
Permit Parking
Gathering Space
Information(student)
Information(security)
Pay Parking
Permit Parking
Bus Stop
Food Services
Interior & Covered Walkways
Exterior Walkways
0 50 100 150 250m
September 2009