CSACS
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International Year of CHEMISTRY 2011

2011 CSACS Student Symposium

20 September, 2011
McCord Museum, Montreal

Centre for Self Assembled Chemical Structures

Centre de Recherche sur les Matériaux Auto-Assemblés


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PROGRAM AT A GLANCE

Morning Session

9:30 am — **Registration and Poster Setup**

10:00 am — **Karina Carneiro (McGill University): *Synthesis and self-assembly of polymer decorated DNA nanotubes***

10:20 am — **Carolin Madwar (McGill University): *Model lipid membranes for Evaluating Specific Cell Responses***

10:40 am — **Cyrille Lavinge (McGill University): *Reversible long range network formation in gold nanoparticle – nematic liquid crystal composites***

11:00 am — **Alireza Shams (McGill University): *Estimation of viscoelastic properties from chromonics liquid crystals defects***

11:20 am — **Ori Gidron (McGill University): *Towards "Green" Electronic Materials: α-Oligofurans as Semiconductors***

11:40 am — **Dylan T. McLaughlin (Concordia University) Chrial Crystallization and Chiral Amplification of Dynamically Racemic Molecules**

12:00pm Lunch *(in the lobby of Otto Maass, 801 Sherbrooke St. West)*

Afternoon Session

1:00 pm* — **Antonella Badia (University of Montreal): *Electroactive Self-Assembled Monolayers as Switchable Interfaces* *Otto Maass, Room10***

2:15 pm — **Poster Session and Refreshments**

3:20 pm — **Vicki Meli, Assist Prof. At Mount Allison University, New Brunswick (former CSACS student, Lennox): *Adventures in Interfacial Self-Assembly from Nanoparticles to Liquid Crystals***

4:00 pm **Hongji Zhang (University of Sherbrooke): *A New Optically Triggered and Spatially Controllable Shape-Memory Polymer-Gold Nanoparticle Composite***

4:20 pm **Oliver Boissiere (University of Sherbrooke): *Flower Micelles of Poly(N-isopropylacrylamide) with Azobenzene Moieties Regularly Inserted into the Main Chain***

4:40 pm **Dehui Han (University of Sherbrooke): *One-Pot Synthesis of Brush Diblock copolymers through Simultaneous ATRP and Click Coupling***

5:00 pm Museum Tour

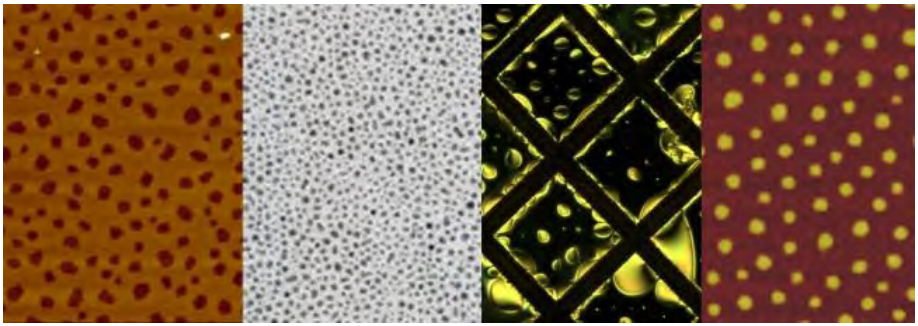
6:00 pm BEST TALK/POSTER ANNOUNCEMENT AND WINE & CHEESE

8:00 pm Adjourn

Adventures in interfacial self-assembly: from nanoparticles to liquid crystals

Vicki Meli, *Department of Chemistry & Biochemistry, Mount Allison University, Sackville, NB*

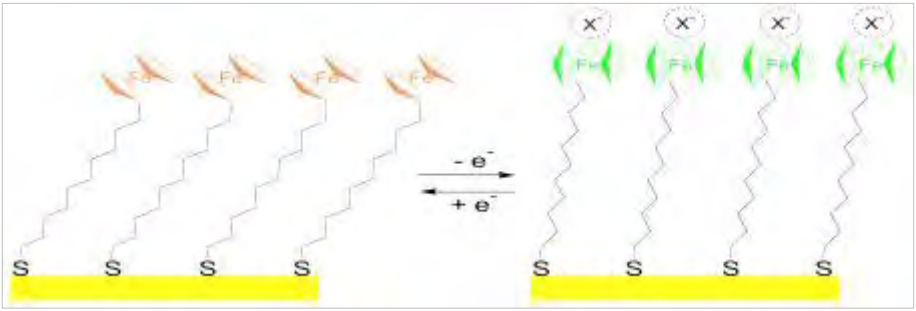
Interfaces, and interfacial forces, have long been used to determine the formation of thin films. Phospholipid membranes (natural or synthetic), and the wetting/dewetting of surfaces such as plant leaves and self-cleaning glass are just a couple of examples illustrating the ubiquitous and vital influence of interfaces on functional materials. In this presentation, the interfacial assembly of lipids as well as less-conventional materials (block copolymers, nanoparticles, thermotropic liquid crystals) into nanopatterned thin films will be explored. Our studies in gold nanoparticle self-assembly at the air-water and liquid crystal-water interface, and the novel effects of alkylthiol chain length, will be described. The coincidental effects on the interfacial anchoring of liquid crystal 5CB to nanoparticle-decorated interfaces, and alkylthiol chain-length dependence, will also be described.



Electroactive self-assembled monolayers as switchable interfaces

Antonella Badia, *Department of Chemistry, University of Montreal*

Organic surfaces that change their conformation or chemical functionality in response to an external trigger, such as light, temperature or voltage potential, are sought after as components in microelectromechanical systems, microfluidic devices, self-cleaning materials, and adsorption templates. We have used self-assembled monolayers (SAMs) of ferrocenylalkanethiolates on gold surfaces as electrochemically switchable interfaces for micromechanical actuation and the controlled assembly of amphiphilic materials. The first part of the talk will address the nature of the oxidation-induced molecular reorientation that occurs in ferrocenylalkanethiolate SAMs. The remainder of the talk will focus on the use of ferrocene-terminated SAMs to trigger the vertical deflection of microcantilevers and the interfacial adsorption of alkylsulfates *via* ion-pairing interactions.



Oral Presentations

A New Optically Triggered and Spatially Controllable Shape-Memory Polymer-Gold Nanoparticle Composite

Hongji Zhang *(Yue Zhao, University of Sherbrooke)*

Shape memory polymers (SMPs) are capable of recovering from a temporarily fixed shape to a permanent shape in response to a stimulus that can either be heat or light or magnetic field, et.al. An overwhelming majority of SMPs developed for specific applications, particularly for biomedical uses, are thermosensitive and respond to a temperature increase across a transition temperature.By employing the photothermal effect of AuNPs, it becomes possible to spatially control the location of shape recovery since only the region exposed to light will undergo the thermal phase transition. Moreover, the amount of heat generated by AuNPs could be adjusted by the intensity of light. This makes it possible to optically tune the rise of the polymer temperature to around Ttransition and to control the rate of stress release and thus shape recovery. Multiple intermediate shapes could be obtained between the initial temporary and permanent shapes.

Chiral Crystallization and Chiral Amplification of Dynamically Racemic Molecules

Dylan T. McLaughlin *(Louis A. Cuccia, Concordia University)*

The crystallization of dynamically racemic and achiral molecules into chiral crystals relies on a molecule's ability to pack asymmetrically in a crystal lattice. Herein, we report an investigation of diphenyl disulfide and benzil that crystallize into conglomerate chiral crystals. We have investigated solution crystallization and melt crystallization to generate homochiral crystals that are analyzed using solid state circular dichroism (KBr pellets and nujol mull). The spontaneous evolution of homochirality from a racemic mixture of these conglomerate crystals is remarkably enhanced under attrition conditions via a process called 'Viedma deracemization'. The amplification to homochirality starting from a racemic mixture of diphenyl disulfide or benzil crystals was achieved within approximately 7 hours and 3 hours, respectively 2400 rpm stirring with 0.8 mm ceramic grinding media).

Estimation of viscoelastic properties from chromonics liquid crystals defects

Alireza Shams *(Alejandro D. Rey, McGill University)*

Liquid crystals exhibit symmetry-breaking phase transitions with defect formation. Liquid crystals under confinement have been interested as their important role in electro-optic technologies and their richness in physical phenomena as a consequence of frustration emanating from fixed orientation at curved bounding surfaces. In this work, we report the results of modeling of discilination line geometry for chromonic liquid crystals, under flat capillary confinement with planar anchoring conditions. Disclination line defect models based on differential geometry and nematoelasticity have been developed, solved and their defect line geometry prediction's compared. Experinamtal results showing a rarely observed process of disclination line splitting have been used to evaluate and validate the theoretical results. It is shown that modeling and experiments of defects processes under confinement yield a comprehensive viscoelastic property set of chromonics liquid crystals solely based on self-organization, anisotropy, and response to surfaces.

Flower Micelles of Poly(N-isopropylacrylamide) with Azobenzene Moieties Regularly Inserted into the Main Chain

Olivier Boissière *(Yue Zhao, University of Sherbrooke)*

A new topological effect was found with the insertion of azobenzene units in PNIPAM. We were able to form some flower micelles that are stable in temperatures and don't aggregate above the LCST of PNIPAM.

Model lipid membranes for Evaluating Specific Cell Responses

Carolin Madwar *(Bruce R. Lennox, McGill University)*

Lipid membrane domains (also known as lipid rafts) are dynamic assemblies of membrane components (phospholipids, cholesterol and proteins) that provide a platform for many cellular functions including signalling and trafficking. In this study, co-existing supported lipid microdomains made from synthetic lipids are utilized to interact with living cells in order to evaluate their responses with different cellular entities and processes. Spherical solid substrates (silica beads) combine the convenience of a mechanically stable platform for performing experiments while providing an environment that closely resembles the biological system being modeled. In addition, they provide a new way to observe relationships between curvature, lipid organization, and phase behaviour in lipid mixtures. The use of spacers between the bilayer and support help reduce adsorption constraints on the supported membranes. Characterization methods including confocal fluorescence microscopy and fluorescence correlation spectroscopy are used to examine the physical and dynamical properties of the co-existing spherical supported lipid microdomains. The interactions of these model membrane domains with living cell membranes are evaluated by targeting specific cellular responses.

One-Pot Synthesis of Brush Diblock copolymers through Simultaneous ATRP and Click Coupling

Dehui Han *(Yue Zhao, University of Sherbrooke)*

Brush diblock copolymers, (PBIEMA-g-PSt)-b-(PAIEMA-g-PEO) were prepared by combination ATRP and Click reaction in one-pot method. The bush main-chain, PBIEMA-b-PAIEMA was firstly synthesized by RAFT polymerization, which containing ATRP initiators in PBIEMA segment and Click coupling functional groups in AIEMA block. The ATRP of St and Click reaction of alkynyl-PEO can be carried out in one-pot and thus the targeted brush diblock copolymers were prepared simultaneously.

Reversible long range network formation in gold nanoparticle - nematic liquid crystal composites

Cyrille Lavigne *(Linda Reven and Alejandro Rey, McGill University)*

Nanoparticles (NPs) are dispersed into liquid crystals (LCs) to template ordered NP assemblies or to modify the LC and NP properties. Although low NP concentrations are normally used to avoid aggregation, high concentrations can lead to new structures through coupling of colloidal crystallization with the LC elastic forces. Through surface coating, gold NPs have been made highly miscible in a nematic host. The interesting phase transitional behaviour of this composite material was studied. A hydrodynamic extension of the mean-field thermodynamic model of Matsuyama *et al.* explained the kinetics leading to the formation of long-range network-like mesostructures in our samples.

Synthesis and self-assembly of polymer decorated DNA nanotubes

Karina Carneiro *(Hanadi Sleiman, McGill University)*

DNA block copolymers are an attractive class of materials as they combine the well defined self-assembly rules of block copolymers with the addressability and rich toolbox of DNA in a single structure. With this in mind, we designed polymer-DNA conjugates with a variety of chemical structures and architectures. These conjugates are amphiphilic in nature, and thus are able to self-assemble in aqueous systems. Furthermore, they can be incorporated into higher-order DNA nanostructures, such as nanotubes[1], through DNA's self-recognition property. The polymer-decorated nanotubes exhibit altered self-assembly behavior when compared to the unfunctionalized DNA analogues. Here, we will discuss the (1) self-assembly of robust DNA nanotubes through rolling circle amplification (RCA) that are amenable to polymer decoration, (2) the synthesis of a variety of DNA-polymer conjugates, and (3) the incorporation of polymers into RCA nanotubes.

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[1] Nature Nanotechnology, 2009, 4, 349-35.

Towards “Green” Electronic Materials: α-Oligofurans as Semiconductors

Ori Gidron *(Michael Bendikov and Dmitrii F. Perepichka, McGill University)*

We have recently introduced new family organic electronic materials, namely long α-oligofurans, containing up to 9 rings, which are the first characterized furan oligomers.[1] Here we report that α-oligofurans, which can be obtained from biomass, could be used as organic semiconductors and show field effect mobilities similar to those of the corresponding thiophene analogues.[2] By virtue of the intrinsically higher fluorescence, higher HOMO, better solubility, and renewable feed-stock for furan derivatives, oligofurans appear to be promising new materials for scalable optoelectronic applications. We anticipate that substitution of sulfur with oxygen in many known materials could lead to the development of new “green" organic semiconductors. In addition, interesting Diels-Alder reactivity and high charge delocalization of oligofurans will be discussed.

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[1] Gidron, O.; Diskin-Posner, Y.; Bendikov, M. J. Am. Chem. Soc. 2010, 132, 2148

[2] Gidron, O.; Dadvand, A.; Sheynin, Y.; Bendikov M.; Perepichka, D. Chem. Comm., 2011, 47, 1976

Posters

01. 2D Self-assembly of an organic semiconductor molecule on a gold surface
Tiffany Hua *(Federico Rosei, INRS Varennes)*

02. AuNP Nano-Architectures with DNA as the Guiding Template
Kai Lin Lau *(Hanadi Sleiman, McGill University)*

03. Azobenzene photoisomerization at high external pressures: Testing the strength of a light-activated molecular muscle
Thomas Singleton *(Christopher J. Barrett, McGill University)*

04. Biotemplating ordered arrays of nanoparticles by thermal dewetting of gold films on Nitzschia Palea
Jonathan Hiltz *(Mark Andrews, McGill University)*

05. Coordination Chemistry of Homoleptic M(II) Complexes Based on an Azadipyrromethene Dye Derivative
André Bessette *(Garry S. Hanan, Université de Montréal)*

06. Diffusion in hydrogel-supported phospholipid bilayer membranes
Chih-Ying Wang *(Reghan Hill, McGill University)*

07. Dynamics of Entangled Polymer Nanocomposites
Ahmad Mohaddespour *(Reghan J. Hill, McGill University)*

08. Electrochemical study of Au(I)-alkanethiolate adsorption on gold
Brendan Pietrobon *(Bruce R. Lennox, McGill University)*

09. Gel Electrophoresis of PEGylated Gold Nanoparticles
Fei Li *(Reghan Hill, McGill University)*

10. ^{1}H-^{1}H Double Quantum Coherence of a series of PMAA hydrogen bonded complexes
Blythe Fortier-McGill *(Linda Reven, McGill University)*

11. Meso-formyl bodipy dyes: sensitive fluorescent sensors for nucleophilic addition studies
Lana Greene *(Gonzalo Cosa, McGill University)*

12. Mono- and multilayer Self-assembly of an amphiphilic zwitterionic quinone at the liquid-solid interface
Yuan Fang *(Louis A. Cuccia, Concordia University)*

13. New Photoresponsive Block Copolymer Vesicles
Bin Yan *(Yue Zhao, University of Sherbrooke)*

14. New Star-shaped Molecules with Azomethines Bonds with Rich Electron Conjugated Compounds and Opto-Electronic Properties
Thomas Skalski *(William Skene, Université de Montréal)*

15. Non Phospholipid Liposomes with High Sterol Content: Development and Characterization
Zhongkai Cui *(Michel Lafleur, University of Montreal)*

16. Organic Electrochemical Transistors for Sensor Applications
Gaurav Nanda *(Dr. Clara Santato, Ecole Polytechnique de Montreal)*

17. Oscillatory Dynamics of Flexoelectric Membranes in a Viscoelastic Media
Edtson Emilio Herrera Valencia *(Alejandro D. Rey, McGill University)*

18. Polymerase-DNA interactions: Exploring the dynamic and structural nature of self-assembled systems critical to viral replication
Ryan Marko *(Gonzalo Cosa, McGill University)*

19. Real time Fluorimetric Monitoring of Covalently Attached Fluorescent Polymer Brushes Grafted to Silica Substrates – Effects of pH and Salt
Iga Borozenko *(Suzanne Giasson, University of Montreal)*

20. Self-assembly of 4,6-di(alkylamino)-*m*-quinones at the air-water and air-solid interface
Demetrios Gritzalis *(Christine E. DeWolf, Concordia University)*

21. Self Assembly of Cationic Lipids on SiO_2 Nanoparticles Coated with Conjugated Polyelectrolytes: A Single Particle Study
Christina Calver *(Gonzalo Cosa, McGill University)*

22. Self-Assembly of Thiol-responsive Amphiphilic Block Co-Polymers at the Air-Water and Air-Solid Interface
Adriano Vissa *(Christine E. DeWolf, Concordia University)*

23. Self-diffusion of functionalized colloidal spheres at soft interfaces
Amir Sheikhi *(Prof. Reghan J. Hill, McGill University)*

24. Statics and Dynamics of DNA in a nanopit lattice
Alex Klotz *(Walter Reisner, McGill University)*

25. Surface composition effects on the redox actuation of microcantilevers functionalized with ferrocenylalkanethiolates
Eric Dionne *(Antonella Badia, University of Montreal)*

26. Synthesis of Click Main-chain Bile Acid Polymers
Olga Ivanysenko *(Julian X. Zhu, University of Montreal)*

27. Synthesis of gallic acid derivatives for the fabrication of functional thin films with biocompatability
Arison Rajasingam *(Christine E. DeWolf, Concordia University)*

28. Towards integration of DNA nanostructures with lipid bilayers: applications in drug delivery.
Tom Edwardson *(Hanadi Sleiman, McGill University)*

29. Unzipping DNA cubes in the presence of a cancer specific gene
Katherine Bujold *(Hanadi Sleiman, McGill University)*

30. Viedma-type attrition-enhanced chiral amplification of conglomerate crystals
Iris Nguyen *(Louis A. Cuccia, Concordia University)*