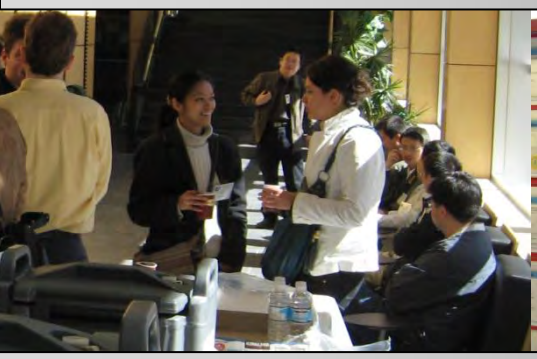
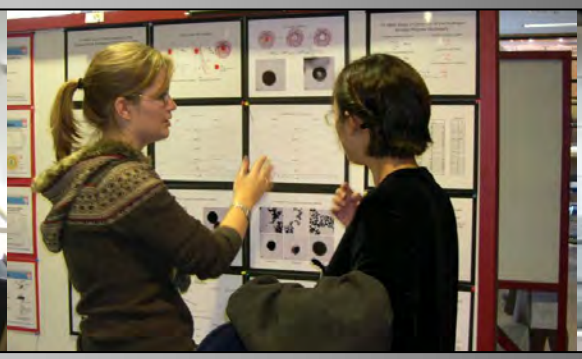
Hosted by/Tenu à: Concordia University

9th/9e Student Symposium
Colloque Étudiant

CSACS CRMAA





September 13, 2013

Science Pavillion
Pavillon des Sciences

Table of Contents


Fonds de recherche
Nature et
technologies
Québec


UNIVERSITÉ
Concordia
UNIVERSITY


INRS
Université d'avant-garde


McGill


UNIVERSITÉ DE
SHERBROOKE


Université
de Montréal


METTLER TOLEDO


CSACS
CRMAA

Special thanks to/Remerciements:

Prof. Louis Cuccia (Concordia University)

CSACS Coordinator: Petr Fiurasek

CSACS Student Committee:

Amir Sheikhi (McGill) – Chair

Alireza Shams (McGill) – Chair

André Bessette (U. de M.)

Andrea Ann Greschner (McGill)

Damien Habault (Sherbrooke)

Fei Li (McGill)

Amani Hariri (McGill)

Janet Belliveau (McGill)

Katherine Bujold (McGill)

Nicole Avakyan (McGill)

Rolf Schmidt (Concordia)

Sahar Eini (Concordia)

Vinod Balhara (Concordia)

If anyone is interested in being a part of the student committee or helping to organize this event next year, please email Petr at *csacs.chemistry@mcgill.ca* or talk to one of the people thanked above.

Les personnes intéressées à participer au comité étudiant ou à l'organisation de cet événement l'an prochain sont invitées à communiquer par courriel au *csacs.chemistry@mcgill.ca* ou à parler avec une des personnes remerciées ci-dessus.

	Schedule / Horaire	Location
9:00	Registration, refreshments, and poster setup Inscription, rafraîchissements, et installation des affiches	lobby of RF
9:50	Welcoming remarks/Discours d'ouverture	**RF110**
10:00	**Chaoying Fu** (McGill University)	**RF110**
10:20	**Wei Chen** (McGill University)	**RF110**
10:40	**Sahar Eini** (Concordia University)	**RF110**
11:00	**Thomas Singleton** (McGill University)	**RF110**
11:20	**Carolin Madwar** (McGill University)	**RF110**
11:40	**Daniel Chartrand** (Université de Montréal)	**RF110**
12:00	Lunch	**CJ Atrium**
12:45	**Poster session 1** (Odd #)	**CJ Atrium**
14:00	**Emily D. Cranston** (McMaster University)	**SP110**
15:20	**Thomas Edwardson** (McGill University)	**RF110**
15:40	**Jonathan Hiltz** (McGill University)	**RF110**
16:00	**Hariri Amani** (McGill University)	**RF110**
16:20	**Audrey Laventure** (Université de Montréal)	**RF110**
16:40	Wine and cheese / vins et fromages	**CJ Atrium**
17:00	**Poster session 2** (Even #)	**CJ Atrium**
18:15	Reception/Vote for best talk and poster Réception et vote pour la meilleure présentation et affiche	
18:30	Announcement of winners/ Annonce des gagnants	
19:00	End of Symposium/ fin du Symposium	

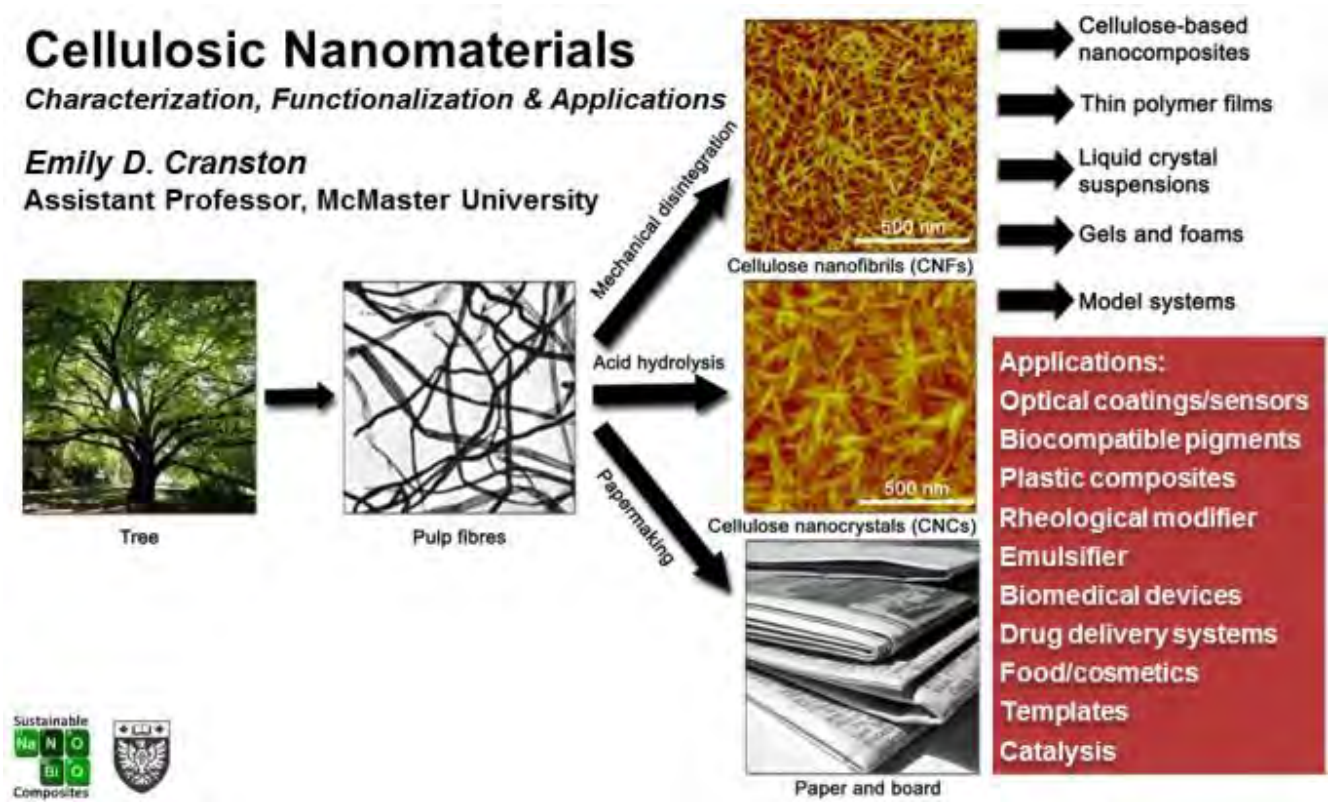
Emily D. Cranston

Chemical Engineering, McMaster University, Hamilton, Ontario, L8S 4L7

Cellulosic Nanomaterials: Characterization, Functionalization and Applications

By learning from nature and using bio-components, we can engineer high-performance materials with improved functionality. A thorough understanding of interfacial and mechanical properties is necessary to design composites with enhanced compatibility between components and favorable material properties overall.

I will present the preparation and characterization of various cellulosic nanomaterials including cellulose nanocrystals (CNCs) and cellulose nanofibrils (CNFs) which are two different colloidal forms of cellulose that can be thought of as cellulosic "rice" and "spaghetti", respectively. CNCs and CNFs shows great promise as composite components because of their unique optical and mechanical properties, light weight, low cost, biodegradability and non-toxicity. Potential applications of these materials include pigments, optical coatings, sensors, biomedical devices, gels, foams or more generally as a substitute for non-biodegradable thermoplastic composites. I will review some new water-based routes to functionalize cellulosic nanomaterials, leading to, for example cationic, hydrophobic and fluorescent CNCs. Finally, the "tool-box" of surface characterization techniques will be discussed, highlighting colloidal probe atomic force microscopy (CP-AFM) and buckling-based mechanical measurements for thin film analysis.



Chaoying Fu (McGill University)

Self-Assembly of p-type, n-type semiconducting building blocks via H-bonding

I will present initial studies on two dimensional self-assemblies of semiconducting building blocks via H-bonding. The first part of my work focuses on the formation of various 2D porous networks by self-assembly of p-type thienoacene building blocks via a carboxylic acid linker. The porous network has a potential to host n-type molecules in a highly controlled fashion, which could be useful in the design of organic electronic devices, in particular, future bulk heterojunction solar cells. The second part of my work focuses on the self-assembly of mono-alkylated naphthalenediimide (NDI) as p-type semiconducting building blocks. The co-assembly between mono and dialkylated NDIs is also explored in order to gain control over molecular domain size in semiconductor blends. For future work, the imide functionality of NDI will be utilized as a three-point hydrogen bonding motif in the complimentary assembly with diamino/dipyrrollo-pyridine structures (p-type semiconducting building blocks). These studies describe progress towards the supramolecular control of packing in organic semiconductors and are expected to impact the emerging field of morphology engineering in organic electronics.

Wei Chen (McGill University)

Cellulose as substrate for the next generation printed circuit boards

Cellulose fibres are biopolymers found in abundance in nature. With the amorphous regions removed, the nanocrystalline portion of cellulose can be extracted, which affords properties that native cellulose does not possess. Of interest to the field of organic electronics is the semiconductive nature of cellulose nanocrystals (CNC). This flexible polymeric film can serve as substrate for integrated circuits and, like silicon, it can be doped to form p-type and n-type layers. Although great progress has been demonstrated by many groups, none have attempted to use traditional methods such as photolithography to print an integrated circuit board. Furthermore, using highly crosslinked hydrophobic paper as enclosure, a thin, light, and flexible microchip can be manufactured. Using standard and commonly known circuitry, today's popular silicon-based printed circuit boards can be emulated using cellulose. Furthermore, as demonstrated recently, a cellulose-tin sodium ion battery exists and can power the device. The dimensions of this machine part would be similar to that of a credit card and weigh less than one.

Sahar Eini (Concordia University)

Effect of inhaled, inorganic particulate on lung surfactant model membranes

Pulmonary surfactant serves to reduce surface tension at the air-liquid interface of the alveoli preventing alveolar collapse. The deposition of nanoparticulate at this interface may interfere with the functional properties of pulmonary surfactant including lowering the film collapse, altering viscoelastic properties and modifying lipid reservoir formation. Previous investigations have focused on the effect of nanoparticles with aqueous dispersions of lung surfactant components, whereas the functional state of lung surfactant films is a monolayer-multilayer equilibrium established at the air-alveolar surface. The focus of this study is the physicochemical changes occurring within the pulmonary surfactant films *via* direct measurements at the air-water interface. The effect of colloidal amorphous silica (SiO_2) nanoparticles (5 to 30 nm diameter) on monolayers of Survanta (a lipid-protein clinical formulation) has been studied. In particular the impact of the nanoparticles on surface pressure – area measurements and film morphology (Brewster angle microscopy) as well as localization of the nanoparticles within the different lung surfactant phases will be presented.

Thomas Singleton (McGill University)

Towards in vivo detection of neurotransmitters using self-assembled biocompatible soft materials

The in vivo detection of neurotransmitter molecules has largely been restricted to invasive and limited-term electrochemical methods. A biocompatible, all-optical method of detection would provide a host of benefits over conventional electrochemical methods. Polyelectrolyte multilayers have been widely characterized and employed in biological systems due to their ability to impart long-term biocompatibility on substrates that would otherwise provoke a foreign-body response in living tissue. In addition, multilayers offer a facile platform for chemical functionalization with photoresponsive molecules, either by physisorption or chemical bonding to the main chain. Derivatives of azobenzene have long been used as indicators for pH due to their large spectral shift over a narrow hydrogen ion concentration range: by creating azobenzene derivatives with complimentary functionality, we are developing analogous sensors for specific neurotransmitter molecules. Both the spectral shift and change in kinetics of thermal cis-trans photoisomerization can be exploited as measures of the presence and concentration of various neurotransmitter molecules. Embedding azo-molecules in a polyelectrolyte matrix that is layered onto an optical fibre, the response from the sensor molecules is read *via* UV-vis spectroscopy and kinetic pump-probe measurements. We will outline our work towards a biocompatible material with a clear optical response to the presence and concentration of neurotransmitter molecules.

Carolin Madwar (McGill University)

Investigating Lipid Domain-Specific Cytoskeletal Organization in Living Cells

The heterogeneous distribution of lipids, proteins, and other membrane components in biological membranes is thought to be fundamental to various cellular events, including signaling, protein transport, lipid sorting and other events mediated by the membrane. The mechanisms involved in the occurrence and maintenance of such lateral heterogeneity within the plane of the biological membrane are not yet understood. Here, we introduce an approach that allows exploration of how co-existing lipid microdomains of a well characterized model system interface with biological membranes at physiological conditions. Co-existing lipid microdomains are formed on a spherical solid substrate [1] and allowed to interact with living cells in culture [2]. This allows for the exploration of the relationship between lipid microdomains on model membranes and the respective organization of cellular cytoskeletal networks in living cells, as a function of membrane heterogeneity. Both actin filaments and microtubules, two major cytoskeletal components, are found to preferentially extend and assemble around the fluid lipid domains presented by the model membranes.[3] Immunofluorescence confocal microscopy was used to examine the cellular membrane organization in relation to the co-existing microdomains on the solid substrate. Because of its experimental versatility, this system can be extended to experiments involving cell culture, live cell imaging, immunocytochemistry and other cell biology related procedures without compromising the structural integrity of the membrane domains on the model membranes.

[1] G. Gopalakrishnan, I. Rouiller, D. R. Colman, R. B. Lennox Langmuir 2009, 25, 5455.

[2] G.Gopalakrishnan, P. Thostrup, I. Rouiller, A. L. Lucido, W. Belkaid, D. R. Colman, R. B. Lennox ACS Chem. Neurosci. 2010, 1, 86.

[3] C. Madwar, G.Gopalakrishnan, R. B. Lennox submitted 2013

Daniel Chartrand (University of Montreal)

The Fate of Rhenium-Rhodium Based Light Harvesting Antennas During Hydrogen Photocatalysis

Up to four rhenium based light sensitizing chromophores are incorporated into a dirhodium based hub structure. This serves as a supramolecular light harvesting antenna which fuels a cobalt based hydrogen evolving catalyst. These assemblies were tested for hydrogen production under various conditions to evaluate their efficiency and endurance, using spectroscopic monitoring. Systems generating 1000+ turn over number of hydrogen per chromophore were obtained and a good understanding of the degradation pathway was uncovered.

Thomas Edwardson (McGill University)

Site-specific positioning of dendritic alkyl chains on DNA cages enables their geometry dependent self-assembly

The selective association of hydrophobic side-chains is a strong determinant of protein organization. We have observed a similar mode of assembly between DNA nanostructures. Firstly dendritic DNA amphiphiles (D-DNA) were synthesized, comprising an addressable oligonucleotide portion and a hydrophobic alkyl dendron at the 5' terminus. DNA amphiphiles have gathered interest recently as they can self-assemble in aqueous media to form well defined micelles while also retaining the ability to hybridize to their complement. Different types of alkyl D-DNA were hybridized to the single-stranded edges of a DNA cube. It was found that anisotropic organization of these hydrophobic domains on the 3D scaffold results in a new set of assembly rules; dependent on spatial orientation, number and chemical identity of the D-DNA on the cubic structure. Combining the highly specific recognition of the oligonucleotide sequence with the orthogonal association of hydrophobic moieties leads to a variety of structures with such diverse applications as membrane anchoring, cell uptake, directed hydrophobic assembly and encapsulation and release of cargo.

Jonathan Hiltz (McGill University)

Marine Diatoms as a Functional Surface for the formation of Patterned Metal Nanostructures

Marine diatoms are a nearly ubiquitous, single-cellular photosynthetic algae whose cell wall is composed of amorphous silica. Different species of diatoms range widely in size and shape, but their silica frustules all contain a richly textured surface topography, made up primarily of hills, valleys and pores, each of these features measuring tens of nanometers to microns in size. Thin gold films, deposited on these highly textured surfaces are annealed at temperatures well below the melting point of bulk gold, leading to dewetting of the films and the formation of patterned arrays of gold nanostructures, driven by the local surface curvature of the frustule. The surface tension between the metal film and the frustule can be modified through chemical functionalization of the silica *via* silane chemistry. Effects of different surface groups on the rate of dewetting and size/shape of the produced particles is also studied.

Hariri Amani (Université McGill)

Visualizing the stepwise growth and exploring the structure and dynamics of DNA nano-architectures: a single molecule study

DNA nanotubes are promising materials with potential applications in medicine, nanotechnology and biotechnology fields. Their unique versatility is the result of their high aspect ratio and encapsulation potential, rigidity, relative ease of preparation and biocompatibility. Our goal is to ultimately exploit the assembly of DNA nanotubes towards a controllable surface patterning in order to generate robust, programmable and functional scaffolds. Preliminary results from our groups have delineated chemical and spectroscopic strategies to assemble and study, respectively, these novel nanomaterials. We are currently involved in investigating, *via* single molecule spectroscopy methodologies, the assembly dynamics of DNA nanotubes. Here, we demonstrate a step by step bottom-up assembly of DNA nanotubes by following their growth on the surface after adding sequentially Cy3-labbeled DNA-rungs and linkers: This is confirmed by single-molecule photobleaching analysis. We next extend our single molecule methodology to the exploration of novel architectures with exquisite positional control. Our studies provide a mechanistic understanding and constitute a step forward towards achieving higher-order control of the assembly of these nanostructures.

Audrey Laventure (University of Montreal)

Turning Mussels Byssal Threads into Electrospun Nanofibers

Mussels anchor to solid substrates by producing proteinaceous fibers called byssus. Although this natural material presents an extraordinary combination of extensibility and rigidity, its unique properties have not been exploited yet – byssus is still treated as waste by mussel farming industries. To develop the exploitation of this so-called "sea silk", we aim to use protein hydrolysate to prepare materials with different morphologies. For the first time, our work demonstrates that electrospinning of byssal hydrolysate solubilised in 1,1,1,3,3,3-hexafluoro-2-propanol (HFIP) successfully leads to continuous and uniform nanofibers. Since residual HFIP was still retained in nanofibers after a vacuum treatment, a method involving ethanol vapors was developed to remove HFIP while keeping nanofibers morphology unchanged. Taking into account that byssus fibers are partly composed of collagenous domains, several physical and chemical cross-linking techniques known to be efficient for collagen-based materials were also attempted: UVC irradiation (254 nm), dehydrothermal treatment (DHT), glutaraldehyde (GA) vapor cross-linking and reaction of carbodiimide (EDC) with N-hydroxysuccinimide (NHS). Even though these treatments did not significantly reduce the nanofibers' solubility in water, the GA and EDC-NHS processes have modified the fibers' morphology while the other treatments did not. This study stands as a proof of concept showing that even a protein hydrolysate can be electrospun in nanofibers if the process conditions are optimized.

Posters:

(1) *Maryam Tavafoghi (McGill University)*

Investigating the prenucleation stage of hydroxyapatite precipitation in the presence of arginine and glutamic acid dissolved in solution

(2) *Anastasia Voitinskaia (McGill University)*

Synthesis of Silatrane Glycol from Diatomaceous Earth

(3) *Anne Dowine de Bruijn (McGill University)*

DNA-metal-complexes for stabilization and branching, chemically replicated by Click chemistry

(4) *Thi Phuong Thao Nguyen (Concordia University)*

Mirror Symmetry Breaking and Attrition-Enhanced Chiral Amplification in Conglomerate Crystals

(5) *Nicole Avakyan (McGill University)*

Coaxing unmodified DNA into forming unique higher-order structures

(6) *Katherine Bujold (McGill University)*

Targeting Prostate Cancer with Self-Assembling Unzipping DNA Nanocubes

(7) *Amlan Kumar Pal (University of Montreal)*

Red Emitting [Ru(tpys/trzs)2(N-N)]2+ Photosensitizers : Emission from a Ruthenium(II)-to- tpys/trzs 3MLCT State in Presence of Ancillary 'Super Donor' Ligand

(8) *Lucie Giraud (Université de Montréal)*

Studies and Characterizations of Surface Properties of Functionalized and Supported Monolayers

(9) *Alexander Greben (McGill University)*

Gradient Polyelectrolyte Multilayers to Assess Surface Biocompatibility

(10) *Alexis Goulet-Hanssens (McGill University)*

Developing Photoresponsive Systems to Guide Biological Growth

(11) *Amélie Tessier (McGill University)*

Investigating physical properties of spherical supported bilayer lipid membranes

(12) *Ryan Dragoman (McGill University)*

Doping Liquid Crystals with Functionalized Zirconium Dioxide Nanoparticles

(13) *Robert Godin (McGill University)*

Improving Dye-sensitized Solar Cells: Single Molecule Studies on Photoinduced Electron Transfer Processes

(14) *Alireza Shams (McGill University)*

Theory and Modeling of Discliniation Lines in Nematic Liquid Crystals under Conical Capillary Confinement

(15) *Sirine Bayram (McGill University)*

Synthesis and Characterisation of Aqueous Silver Nanoparticles

(16) *Tina Lam (McGill University)*

Designing Superparamagnetic Iron Oxide Nanoparticles Based Nanoprobes for Detection of and Delivery to Vulnerable Atherosclerotic Plaque

(17) *Taylor Aubry-Komin (McGill University)*

Small Molecule Optical Sensors for Neurotransmitter Detection

(18) *James Harrison (McGill University)*

Irradiation and Temperature Effects on the Nanomechanical Properties of Azo-Polymers

(19) *Jean-Louis Do (McGill University)*

Accelerated Aging of a Metal Oxide System: The Reactivity of Nickel (II) Oxide in the Assembly of Metal-Organic Complexes and Frameworks

(20) *Mathieu Bédard (McGill University)*

Designing Multifunctional Gold Nanoprobes for Atherosclerosis Theranostics

(21) *Jessica Wong (McGill University)*

Monitoring mechanochemical supramolecular cocrystal formation using fluorescence

(22) *Oleksandr Bushuyev (McGill University)*

Photo-switching of Perhalogenated Azobenzenes in Crystals and Halogen-bonded Polymers

(23) *Adam Langlois (University of Sherbrooke)*

Going Red: Searching for Low-Band Gap Conjugated Polymeric Materials

(24) *Mohammed Abdelhameed (University of Sherbrooke)*

Di(imine(tetraarylzinc(II)porphyin))di-□-(amine(tetraarylzinc(II)porphyin))quinone as a Model for Conjugated and Unconjugated Porphyrin Dye Polymers.

(25) *Antoine Bonnot (Université de Sherbrooke)*

Ligands and Halides Effects on the Resulting Structure and Photophysical Properties (CuX)n Cluster-containing Monothio- and Dithioether coordination polymers (X = Br, I; n = 2-6).

(26) *Mien-Chien Yu (University of Montreal)*

Fluorescent Probe-Mediated Visualisation of the Inhibition of BSP1-Induced Perturbations of Membrane Permeability

(27) *Mahdi Roohnikan (McGill University)*

Nanoparticle/Liquid crystal hybrids based on hydrogen bonding interactions

(28) *Gianna Di Censo (Concordia University)*

Structure and Biophysical Studies of Parallel Stranded poly-Adenosine Duplexes

(29) *Graham Hamblin (McGill University)*

Optimizing DNA Nanotube Design for Future Applications

(30) *Derek O'Flaherty (Concordia University)*

Structural Studies on Interstrand Cross-linked DNA Probes by NMR to Rationalize their Interaction with O6-Alkylguanine-DNA Alkyltransferases

(31) *Mohamed Amine Mezour (McGill University)*

Two-Dimensional Molecular Networks

(32) *Justin Conway (McGill University)*

Dynamic Assembly and Networking of DNA Cages on Supported Bilayers: Tools for Investigating Interfacial Phenomena

(33) *Erum Mansuri (Concordia University)*

Surface Behavior of Novel Boronic Acid-Derived Silicone Surfactants

(34) *Timothy Mack (McGill University)*

Spectroscopic Characterization of Fluorescently Labelled Nanocrystalline Cellulose

(35) *André Bessette (Université de Montréal)*

Development of New Photosensitizers with Extended NIR Absorption Properties for Dye-Sensitized Solar Cells based on Cyclometallated Aza-Dipyrromethene on Neutral Ruthenium Complexes

(36) *Kateryna Borozenko (University of Montreal)*

Fabrication of nanostructured ultrathin films as a first step to produce aligned nanoparticles

(37) *Janane Rahbani (McGill University)*

Stimuli- Responsive DNA Nanotubes