

**CQMF
QCAM**



COLLOQUE ÉTUDIANT
STUDENT SYMPOSIUM

LUNDI LE 9 MAI 2022
MONDAY MAY 9TH 2022

**CARNET DE RÉSUMÉS
ABSTRACT BOOKLET**

WWW.CQMFQCAMCONFERENCE.COM

Table of Contents

1. Commanditaires/Sponsors	3
2. Mot de bienvenue/Welcoming remarks	4
3. Résumés des présentations/Talks abstracts	5
Séance/Session 1 – Polymères et auto-assemblage/Polymers and self-assembly	5
Séance/Session 2 – Énergie/Energy	8
Séance/Session 3 – Biomédical/Biomedical	11
Séance/Session 4 – Énergie/Energy	14
Séance/Session 5 – Nanosciences	17
Séance/Session 6 – Énergie/Energy	21
4. Présentations par affiche/Poster presentations	25
5. Atelier sur l'art de l'entrevue et de la négociation en embauche/ Workshop on the art of interviews and negotiation at hiring - Gad Sabbatier.....	27

1. Commanditaires/Sponsors



Nous remercions chaleureusement nos commanditaires *Platine* du Colloque annuel du CQMF 2022 pour leur soutien.

We sincerely thank our Platinum sponsors of the 2022 QCAM Annual Symposium for their support.

2. Mot de bienvenue/Welcoming remarks

C'est avec grand plaisir que le comité étudiant du CQMF vous accueille au Campus MIL de l'Université de Montréal pour le Symposium étudiant 2022 du CQMF. Ce sera l'occasion de mettre de l'avant les travaux de recherche des étudiant.e.s de notre communauté et de stimuler le dialogue entre professeur.e.s, industriel.le.s et étudiant.e.s.

Ce *carnet de résumés* contient l'horaire de la journée, les résumés des présentations orales étudiantes (classés par séance de présentation), les titres des présentations par affiche, ainsi qu'un court résumé de l'atelier sur *l'art de l'entrevue et de la négociation en embauche* proposé par Gad Sabbatier.

Nous vous invitons à rester jusqu'à la fin de la journée pour notre activité quizz et réseautage, dans le cadre de laquelle des bouchées seront servies et un prix additionnel sera remis !

Le comité étudiant du CQMF

-

It is with great pleasure that the QCAM student committee welcomes you to the University of Montreal's MIL Campus for the 2022 QCAM Student Symposium. This will be an opportunity to highlight the research work of students from our community and to stimulate dialogue between professors, industrials and students.

This *abstract booklet* contains the schedule for the day, abstracts of the student talks (sorted by presentation session), titles of the poster presentations, as well as a short summary of the workshop on *the art of interviews and negotiation at hiring* proposed by Gad Sabbatier.

We invite you to stay until the end of the day for our quiz and networking activity, where appetizers will be served and an additional prize will be awarded!

The QCAM student committee

3. Résumés des présentations/Talks abstracts

Séance/Session 1 – Polymères et auto-assemblage/Polymers and self-assembly

Efficient Room Temperature Phosphorescence of Covalent Organic Frameworks via Covalent Halogen Doping

Ehsan Hamzehpoor, Dmitrii Perepichka

McGill University

Phosphorescent materials show a tremendous potential for applications in bioimaging, photodynamic therapy, high-efficiency light-emitting diodes, and data encryption. Phosphorescence results from the relaxation of electrons from the lowest-energy triplet state (T1) to the ground state (S0) which is a spin-forbidden process. Heavy metal complexes (Ir, Pt, etc.) can enable this forbidden process by spin-orbit coupling, however, it is generally inefficient in organic materials. As a result, purely organic room temperature phosphors (ORTPs) are scarce, yet of great interest due to their biocompatibility, widely tailored properties, and low cost. Nonetheless, the rational design of ORTPs is a fundamental and still unaddressed challenge.

Recently, we investigated the principles of achieving phosphorescent materials in an emerging class of porous organic materials, covalent organic frameworks (COFs), in which the topology of the solid-state can be readily designed using reticular chemistry. Using this approach, highly phosphorescent COFs were designed using covalent doping of the parent benchmark COF-1 with halogens. The permanent porosity of the COFs enabled us to realize the first COF-based oxygen sensor, with rapid response and a wide dynamic range, from atmospheric to $<10^{-5}$ torrs of partial oxygen pressure.

Molecular Organization in n-Alkanethiolates Formed on Non-Ultraflat Gold

Fadwa Ben Amara, Sahar Kassir, Marie Dessoude, Christian Pellerin, Antonella Badia

Université de Montréal

A high molecular organization in organic self-assembled monolayers (SAMs) has been associated exclusively with ultraflat metal substrates in previous work. However an odd-even effect has been observed in the apparent redox potential of self-assembled monolayers (SAMs) of ferrocenylalkanethiolates ($\text{Fc}(\text{CH}_2)_n\text{S}$) chemisorbed to microscopically rougher thermally evaporated gold thin films, suggesting that organizational order can be achieved on non-ultraflat surfaces. In this presentation, we aim to show that the roughness of the metal surface should not be the sole criterion considered to yield a highly organized SAM.

Indeed, wettability studies (static contact angles) and surface tension calculations for n-alkanethiolate SAMs on both thermally evaporated and sputtered gold thin film substrates show an odd-even effect. This parity effect is attenuated in SAMs formed on sputtered gold thin films, despite both substrates having statistically identical RMS surface roughnesses. The infrared absorption reflection spectroscopy (IRRAS) results agree with the conjectures made from the wetting properties.

The IRRAS findings also highlight structural differences between the methyl-terminated SAMs formed on the different substrates, attributed mainly to the backbone twist angle resulting from the different gold crystallographies.

A Novel Approach to Three-Dimensional Whole Mounted Imaging of Microplastics

Jun-Ray Macairan, Brian Nguyen, Nathalie Tufenkji

McGill University

With ever-growing concerns over plastic pollution, there is a need to understand the impacts of plastics in the environment. Studying plastic pollution requires an effective methodology to detect micrometer sized polymer particles in environmental samples and organisms. To date, detecting and quantifying microplastics in a biological system generally required liquefying biomass via digestion. While digestion can effectively recover microplastic, it results in the loss of spatial information on the distribution of microplastic within an organism. Fluorescence microscopy allows visualization of microplastic uptake but requires fluorescently labeled microplastic. Unfortunately, these labeling strategies are non-specific and label biomass, which prevents effective visualization of the embedded microplastic. In addition, studies using pre-labelled microplastics (prior to exposure studies) can affect the viability of the organism and could potentially impact the overall uptake mechanism of the plastics. To address these shortcomings, we developed a method that utilizes non-specific labeling in conjunction with a tissue clearing technique. In brief, tissue-bound fluorescent dye is removed, while the structurally intact organism is rendered transparent, and the fluorescent dye remains bound to plastic. This process results in a sample with fluorescently labeled plastic that can be rapidly imaged in three dimensions with light sheet microscopy. We demonstrate this technique with model aquatic organisms including *T. californicus* and *D. magna*.

Towards a Li-ion Photo-Battery

Elsa Briqualeur, W.G Skene, Mickael Dollé

Université de Montréal

An organic dye was judiciously chosen because it met the physical and electrochemical requirements for its use in an integrated photobattery. The selected dye had an intrinsically broad absorption in the visible spectrum, high degree of colorfast, and was photostable. Given its ideal properties, the dye was systematically evaluated for its use as the photoactive component of a photobattery. Specifically, the photoreduction of the dye with the battery active components was evaluated in solution through spectroscopic quenching measurements. Those were done to provide unequivocal evidence of the key electron transfer process between the constitutional “solar” and “battery” components that govern the photobattery operation.

Different photo-electrode architectures were compared by evaluating their fluorescence. Their electrochemical properties and microstructure were verified by galvanostatic cycling and SEM. Raman spectroscopy was used to identify the key constitutional components that are required for promoting solid-state intermolecular electronic transfer. Towards improving the environmental footprint of the battery, it will further be demonstrated that environmentally benign water can be used to enable the battery.

Electrodeposition of Inorganic Cesium Lead Mixed-Halide Perovskites

Tao Liu, Joshua Byers

Université du Québec à Montréal

Cesium-based halide perovskites have attracted tremendous interest for stable and efficient photovoltaics due to their tunable optical and electronic properties. Among the preparation methods of perovskites, electrodeposition has been demonstrated as a scalable and reproducible technique to fabricate high performance solar cells. Herein, electrodeposition and chemical conversion were combined to access inorganic cesium lead mixed-halide perovskites (CsPbX_3 , $X = \text{I, Br, Cl}$ or their mixture). Their bandgap (E_g) was tuned by controlling the halide stoichiometry in the thin films, which was achieved by varying the solution composition used during chemical conversion. Measurements of the structural and (photo)electrochemical activity of the CsPbX_3 thin films will be presented for studying the relationship between composition/structure and optoelectronic properties of perovskites.

Understanding the Effects of Replacing Cr by Fe on the Hydrogen Storage Properties of the Body Centered Cubic (BCC) Alloy Ti₁₆V₆₀Cr₂₄

Francia Ravalison, Jacques Huot

Université du Québec à Trois-Rivières

The effects of the substitution of Cr by Fe on the hydrogen storage properties of the bcc alloy Ti₁₆V₆₀Cr₂₄ were investigated. Seven different alloys were studied: Ti₁₆V₆₀Cr_{24-x}Fe_x (x= 0, 4, 8, 12, 16, 20, 24). Micrograph of each alloy has shown two main phases such as a matrix and a bright phase. For x=0 and 4, the secondary phase is randomly distributed within the matrix. When x= 8 and more, it got stick until a line of percolation is reached. Concerning the x-ray diffraction patterns, from x= 4 to 12, the crystalline structure consists of a pure BCC while from x= 16 to 24, C14 Laves phases appear. The lattice parameter of the BCC phase is decreasing with increasing the Fe content. This is in accordance with the Vegard's law. Moreover, the hydrogen storage maximum capacity is decreasing with increasing Fe content, this can be explained by combination the reduction of the lattice parameter of the BCC phase and the increase of the secondary phase seen in the micrographs. Pressure composition isotherm (PCI) curves were recorded at 298 K, 303 K and 323 K that permit to deduce the Van't Hoff plot to get the enthalpy and entropy of formation of each hydride. The systematic relation between these thermodynamic parameters will be further studied.

Young's Modulus Determination of Thin Polycaprolactone Membrane using Viscoelastic Mapping Mode in AFM

Rathosivan Gopal, Ayoub Tanji, Syafiqah Saidin, Hendra Hermawan

Laval University

Postoperative complications followed by cardiac surgery require specific measures to protect the patients. Cardiac bleeding is one of them which adversely impacts patients' life unpredictably. Blood therapy, medications and re-exploration are some of the options which derange the resources and cost. Oral administration of coagulation factor VII (FVII) has been effective to stop the bleeding. However, the short half-life and frequent intake may lose the effectiveness and cause inconvenience. Alternatively, synthetic polymers such as polycaprolactone (PCL) is used in drug delivery and wound dressing application due to its properties of biocompatibility, high miscibility, biodegradability, and moldability. Therefore, this work fabricated a thin PCL membrane immobilised with FVII to be applied as a sealant after cardiac surgery. Withstanding active myocardium movement is crucial for a cardiac sealant. Hence, the nanomechanical properties of this membrane were explored through amplitude modulation – frequency modulation (AMFM) mode in atomic force microscopy which map the nanomechanical properties and morphology simultaneously. The obtained results were compared with tensile test values and used to deduce the precision of the AMFM measurements. It was found that the young's modulus for neat PCL membrane was 69.3 ± 10.6 MPa which was significantly higher from the referenced literature (7.6 ± 0.9 MPa) due to the changes during fabrication technique. However, the values were within the range (10 MPa–230 MPa) of typical PCL membranes fabricated through solvent-evaporation casting method. Neat PCL membrane was used as the reference to calibrate the values for PCL membranes with FVII and found to be within similar range. Tensile test corresponds to the entire sample while nanomechanical characterisation is a localised evaluation. AMFM may not be very close to the entire representation of the sample. Nevertheless, AMFM protects the sample and its surface as compared to the tensile test and nano-indentation mode. Hence, AMFM mode demonstrated to be efficiently map viscoelastic properties of PCL. Future works will be focused on standardising calibration measurements to instantly map various type of materials.

Effect of Niobium Addition on the Corrosion Resistance of TiHfZrNb_x High-Entropy Alloys in a Hanks' Solution

Ayoub Tanji, Hendra Hermawan

Université Laval

High-entropy alloys HEAs possess excellent structural, mechanical, and anti-corrosive properties for potential applications in the biomedical field. TiHfZrNb_x demonstrated a strong mechanical behavior, and it's particularly made up of very passivating elements with very good biocompatibility, which can be interesting for permanent-stent material. This work is an electrochemical characterization of the effect of the Niobium content on the corrosion resistance of the TiHfZrNb_x alloy.

The TiZrHfNb_x HEA with nominal compositions of (in molar ratio, $x = 0.2, 0.3,$ and 0.4 labeled as Nb_x) were fabricated by arc-melting mixtures of pure elements (Ti, Zr, Hf, and Nb) in the Ti-gettered argon atmosphere and cast into a water-cooled copper mold. The electrochemical-corrosion investigation was performed, utilizing a three-electrode set-up with HEAs specimens, saturated calomel electrode (SCE), and graphite as working, reference, and counter electrodes, respectively. All tests were performed in a Hanks' solution at 37 °C. Cp-Ti and Ti6Al4V are employed as references.

The electrochemical results showed that the TiHfZrNb_x have a nobler and more corrosion resistant character than the CP-Ti and Ti6Al4V references, based on the E_{OCP} , E_{corr} , and E_{pit} potential measurements. It should also be mentioned that the corrosion resistance increases by increasing the Nb content. In addition, the HEAs presented a negative-type hysteresis loop unlike the references, providing information on better repassivation. EIS results indicated a non-diffusional corrosion character for HEAs, hence the equivalent circuit model and its parameters showed that the charge transfer resistance and oxide film resistance of HEAs are greater than those of CP-Ti and Ti6Al4V and they increase with increasing Nb content.

The addition of 0.4Nb improved the corrosion resistance and surface characteristics of TiHfZrNb_x by enhancing the passivation and charge transfer resistance of the oxide film, as well as improving the nobility of HEA by shifting the potentials thermodynamics to more positive values.

Caractérisation toxicologique de différentes espèces chimiques de zirconium en utilisant le modèle Lemna minor

Mohamadou Diallo, David Dewez

Université du Québec à Montréal

Le zirconium (Zr), est un métal de transition relativement abondant dans la croûte terrestre. En 2020, la production mondiale est estimée à 1,7 million de tonnes, le tétrachlorure de zirconium ($ZrCl_4$) et les nanoparticules d'oxyde de zirconium ($nZrO_2$) sont largement utilisés dans les applications industrielles et biomédicales. Leurs utilisations de plus en plus croissantes entraînent des rejets dans l'environnement et pourraient avoir des effets néfastes sur les organismes aquatiques et leurs écosystèmes. La plante aquatique Lemna minor, en raison de sa petite taille, de sa reproduction rapide dans des conditions contrôlées et de sa sensibilité aux substances toxiques, est utilisée comme modèle d'étude. Notre objectif est de caractériser les propriétés physico-chimiques du $ZrCl_4$ et $nZrO_2$, d'étudier les mécanismes de toxicités et d'évaluer leurs effets sur la physiologie de la plante. Nos résultats sur la caractérisation ont permis de constater la présence d'environ 40% des ions Zr_4^+ libérées par la forme $ZrCl_4$ et près de 10% par $nZrO_2$, et ce dernier sous l'effet de la concentration a tendance à s'agglomérer et sédimenter. Une exposition de la plante à des concentrations allant de 0 à 25 ppm de $ZrCl_4$ et $nZrO_2$ pendant 7 jours, a permis de constater environ 25 % d'inhibition de la croissance à 25 ppm. Les résultats de la bioaccumulation ont montré une forte accumulation des ions Zr_4^+ libérés par le $ZrCl_4$ à 25 ppm, en comparaison à ceux libérés par $nZrO_2$. Des tests sont en cours pour déterminer la (CE_{50}) concentration inhibant 50 % de la croissance de la plante et par la suite évaluer leurs mécanismes de toxicité. C'est la première étude montrant la différence dans les mécanismes de toxicité du $ZrCl_4$ et $nZrO_2$ pour la plante aquatique Lemna minor en apportant de nouvelles connaissances dans le comportement et le devenir de ces contaminants émergents dans l'environnement aquatique.

Synthesis and Characterization of Donor-Chromophore-Acceptor (D-C-A) Copper(I)-Based Photoelectrodes for Photoredox Catalysis

Zujhar Singh, Marek B. Majewski

Concordia University

Molecular photosensitizers and fuel forming catalysts can be covalently attached or adsorbed onto heterogeneous semiconductor surfaces effectively constructing a dye-sensitized photoelectrochemical cell (DS-PEC). To-date, most molecular photosensitizers used in DS-PECs are ruthenium-based and focus has shifted to developing new photosensitizers that are comprised of Earth abundant elements. $[\text{Cu}(\text{NN})(\text{NN})]^+$ -type (NN = diimine ligand) complexes possess similar ground- and excited-state properties to those of ruthenium analogues. The major drawbacks of using these complexes as photosensitizers includes their short-lived excited state lifetimes and ligand lability in the excited distorted tetrahedral geometry. The former can be overcome by utilizing donorCu(I)-acceptor (D-C-A) systems so that the generated hole and electron pairs are spatially separated and yield slower recombination rates whereas the latter can be resolved by providing steric bulk around the copper center.

With this in mind we have synthesized new ligands in which electron donors and acceptors are on a 1,10-phenanthroline scaffold. These ligands are carefully designed to perform dual function as electron donors/acceptors as well as anchoring to the semiconductor electrode surface. We have successfully synthesized new D-Cu(I)-A complexes using these ligands and after examining their ground- and excited-state properties, these complexes were grafted onto either n-type (ZnO) or p-type (NiO) semiconductors to construct photoanodes or photocathodes, respectively. Chronoamperometric methods were used to test the electron/hole injection into the semiconductor surfaces. In the case of photoanodes, the generated holes on the surface are transferred to an oxidation catalyst to drive processes such as water and alcohol oxidation. Conversely, in photocathodes, the generated electrons are transferred to a proton reduction catalyst.

One-Pot Synthesis of LiAlO_2 -Coated $\text{LiNi}_{0.6}\text{Mn}_{0.2}\text{Co}_{0.2}\text{O}_2$ Cathode Material for High Performance Lithium-Ion Battery

Quardia Touag, Gael Coquil, Mathieu Charbonneau, Denis Mankovsky, Mickael Dollé

Université de Montréal

The chemistry of lithium-ion batteries (LIBs) is an active area of research, notably through the increasing demand for high energy and power density in LIBs, especially for application in electric vehicles (EVs) and hybrid electric vehicles (HEVs).

Among the various cathode materials, $\text{LiNi}_x\text{Co}_y\text{Mn}_{1-x-y}\text{O}_2$ (NMC) intercalation compounds are the best candidates for applications in high performance LIBs. However, Ni-rich NMC suffers mainly from parasitic side reactions at the interface with the electrolyte, which leads to a lower thermal and electrochemical stability. Surface modification via coating is an effective concept to counter the capacity degradation of NMC and to improve the particles' structural stability for enhancing their cycle-life. Different processing techniques that usually requires several steps are presented in the literature. However, to facilitate the integration of a new product in the current battery market, it is preferable to reduce the number of steps during the synthesis process. In this work, we propose a one-pot synthesis of LiAlO_2 -coated $\text{LiNi}_{0.6}\text{Mn}_{0.2}\text{Co}_{0.2}\text{O}_2$ particles, by using a continuous stirred-tank reactor (CSTR).

Firstly, the composition and morphology of the coated and uncoated cathode materials are characterized by SEM, TEM, EDX and XPS. Then, the structural characterization of our materials is validated by XRD analysis. Consequently, we will compare the electrochemical performance and thermal stability of coated and uncoated NMC particles.

We will demonstrate that our approach provides an easy way to apply surface treatment onto Ni-rich NMC particles and simplifies the synthesis process at large scale production.

Synthesis of Fluorescent Carbon Nanoparticles by Dispersion Polymerization of Acetylene

Vijay K. Jayswal, Anna M. Ritcey, Jean-François Morin

Université Laval

Carbon nanoparticles (CNPs) have emerged as one of the most promising nanomaterials due to their distinct optoelectronic properties for a diverse range of applications in the area of electronics, energy conversion/ storage, and bio-imaging. The uniqueness in terms of functions and properties of the CNPs gets more interesting as it changes distinctly with a change in the shape, size, and dimensionality of these nanoparticles. The synthetic methods reported until now involves high-temperature ($>100\text{ }^{\circ}\text{C}$) processes, which often results in uncontrolled shape, size, and polydispersity. In this work, we focus on the development of a low-temperature synthetic method for the preparation of fluorescent carbon nanoparticles allowing precise control over the shape, size, and properties by dispersion polymerization of acetylene as a precursor. The shape- and size-tunable nanoparticles were synthesized in a single step with dispersion polymerization by Glaser-Hay coupling. The shape and size of the resulting carbon nanoparticles are controlled by changing different reaction parameters such as temperature, reaction time and pressure. The control over the different reaction parameters allows us to obtain monodisperse CNPs in spherical (and tubular) shape with a size in the range of 25 nm to 250 nm. The use of low-temperature methods ($\text{RT} < T < 70\text{ }^{\circ}\text{C}$) also allows us to overcome the limitations associated with current methods. After isolation, CNPs were characterized by microscopy techniques to analyze their shape and size. The nanoparticles were further characterized to by various techniques for chemical composition, structure, morphology, and optical properties. The residual alkynes in the CNPs' structure were exploited for further post-functionalization/graphitization to yield multifunctional CNPs, which were fluorescent in the blue region.

Development of Muldimodal Imaging Probes Using Carbon Dots

Diego Mendoza, Rafik Naccache

Concordia University

Molecular imaging techniques have a significant role to monitor human health. However, these techniques possess some limitations. In this context, the design of probes that can be suitable for multiple molecular imaging techniques has been proposed as a new approach to address the issue. Most recently, carbon dots (CDs) have attracted significance in the medical field because of their biocompatibility, an important characteristic for clinical applications. This class of nanoparticles has demonstrated to improve the efficiency of molecular imaging techniques and help diagnose diseases even at early stages.

Herein, a dual-modal carbon-based nanomaterial functionalized with a transition metal ion, Mn^{2+} , is presented. The intrinsic fluorescent properties of the carbon dots, attributed to the functional groups on their surface, make them suitable as fluorescence imaging probes while the coupling of metals using a chelating agent, diethylenetriaminepentaacetic acid, (DTPA), and a cross-linker, (1-ethyl-3-(3-dimethylaminopropyl) carbodiimide hydrochloride) (EDC), will tailor them as magnetic resonance (MR) imaging probes.

Energetics of the Doping of Organic Semiconductors by Lewis Acids

Michael Berteau-Rainville, Emanuele Orgiu

Institut National de Recherche Scientifique

The (p-)doping of organic semiconductors (OSCs) for applications in thermoelectrics and electronics is usually done via the admixture of molecular dopants with an electron affinity that must be high enough to remove electrons from the organic semiconductor, thus increasing its density of positive charges. This high electron affinity requirement severely limits what molecules can be used, hence the search of alternative doping schemes. Here we use Lewis acids (LAs) as dopants for OSCs, which are effectively able to dope them despite the known, far insufficient tendency of such molecules to accept electrons. The use of LAs to dope OSCs spread rapidly in the last years despite the absence of a mechanism explaining this behavior, allowing to obtain several record-high performances in electronic device of various types. A tentative mechanism was more recently put forward, wherein the doping proceeds thanks to water impurities [1]. Such a mechanism, however, is understood to be extremely unfavorable for the products, requiring long reaction times and large energy inputs via stirring and/or heating in solution in order to proceed.

In our experiments, poly(3-hexylthiophene) (P3HT) was doped with the strong LA tris(pentafluorophenyl)borane (BCF). Quite surprisingly, we found that the doping occurs immediately after the admixture of BCF to P3HT in solution, compared to the typical scenarios where several hours or even days of stirring is needed for the reaction to occur. DFT calculations reveal that doping, were it to occur as proposed because of water, should, in agreement with the understanding of this mechanism, indeed occur on long timescales and necessitate large energy inputs. Currently ongoing calorimetric measurements of the reaction appear to show that the reaction is endothermic in addition to being spontaneous, implying that it must be entropy-driven. These thermodynamic considerations presented here, which have not been explored so far, suggest that a different reaction pathway must be involved in the doping, the nature of which will be discussed.

The Piezoelectric Contribution in the Catalytic Activities of BaTiO₃ Nanoparticles

Hossein Kalhori, Azza Hadj Youssef, Andreas Ruediger, Alain Pignolet

Institut National de la Recherche Scientifique

There is an increasing demand to protect the environment from the different kinds of pollutants especially industrial pollutants. Waste water treatment is an example of these effort that is necessary for the future of the mankind life. Recently, using the piezoelectric effect of nanomaterials as the catalyst of water purification has been noticed. In general, the piezoelectric polarization can be used for the degradation of organic pollutants. Besides, its potential application, the understanding of the basic physics of the piezocatalytic activity would be more interesting. In the other hand, a tribocatalyst activity that comes from the frictions of the particles can cause the production of the transient charges suitable for the degradation of organic pollutions. Moreover, sonocatalysis may also occur in the exactly the same way as these effects. As a physical point of view, a general literature review shows that there is not enough attention to discriminate between these effects while measuring the pollutant degradation of piezocatalyst materials such as BaTiO₃ nanoparticles. In this report, we try to quantify the piezo-tribo and/or sonocatalytic activities of BaTiO₃ nanoparticles using a comparison with non-piezoelectric TiO₂ nanoparticles in order to derive the weight of the piezoelectric effect in the catalytic reactions. BaTiO₃ and TiO₂ nanoparticles were characterized using XRD and Raman spectroscopy in order to obtain their crystalline phase of each. Then, the degradation of methyl orange in water is measured while BaTiO₃ and TiO₂ were applied separately as catalysts. The results can direct us to an approach to quantify the portion of each effect in an applied catalytic activity of BaTiO₃ nanoparticles.

C-N Triple Bond Cleavage Via Trans-Membrane Hydrogenation

Yuxuan Zhang, Nikolay Kornienko

Université de Montréal

Renewable energy powered electrosynthesis is an emerging green alternative to thermochemical routes. Against this backdrop, acetonitrile valorization is an important target as it is industrially produced in excess. In this work, we have developed a catalytic system which converts acetonitrile into acetaldehyde and NH₃ using a H-permeable Pd membrane reactor. In this system, H is abstracted from water in an aqueous electrolyte, transferred across the Pd membrane and is used to hydrogenate acetonitrile with up to 60% Faradaic efficiency (FE) for NH₃ generation. Further, we have constructed a unique infrared (IR) spectroelectrochemical cell that enabled us to probe the reaction as it occurred. This helped us deduce that the reaction proceeded through an imine hydrolysis pathway. Finally, we extended the scope of this system to 4 additional nitrile reactants. In all, this work establishes a new electrochemical route to nitrile hydrogenation and opens up promising avenues in electrosynthetic technologies.

Elemental Analysis and Mapping of Solid-State Li-Ion Battery Materials using Laser-Induced Breakdown Spectroscopy

Marie-Chloé Michaud Paradis, Mickaël Dollé

Université de Montréal

As opposed to elemental analysis methods requiring a tedious digestion of the material, laser-induced breakdown spectroscopy (LIBS) requires no prior sample preparation and provides spatial distributions of elements in point-to-point scanning. Furthermore, all elements of the periodic table exhibit selective emission patterns and light elements such as lithium and sodium exhibit noticeably high sensitivities. When studying synthetic materials, solid-state elemental analysis of trace impurity distributions within the material and elemental ratios may help toggle performances of functional synthetic materials. This study aims toward presenting LIBS as an ultra-fast elemental analyzer of battery materials and such, as a phase-specific sensor, and as a tool to map synthetic materials trace impurities.

Molecular Copper(I) Photosensitizer and Cobaloxime Photoelectro-catalyst for Proton Reduction

Linyi Wei, Zujhar Singh, Marek B. Majewski

Concordia University

Previously, our group has shown that a copper(I)-based donor-chromophore-acceptor molecular system immobilized on a zinc oxide photoanode together with a copper(II)-based water oxidation catalyst can act as a light-harvesting photocatalytic assembly to split water. To enable the complementary reaction to reduce the protons formed from water splitting, we have designed a photocathode comprised of a copper(I)-based chromophore-acceptor dyad complex to drive a well-studied cobaloxime hydrogen evolving electro catalyst with visible light. In this work, this dyad complex will be installed on fluorine doped- tin oxide glass with a nickel oxide film and will work in concert with the previously studied photoanode to give a tandem cell where hydrogen gas as a solar fuel is expected to be produced effectively. However, we have not finished all the research plan until now, more detailed characterizations of this device will be finalized in the future work. The presentation will outline our present efforts toward this final device, highlighting the synthesis and characterization of the molecular components as well as preliminary investigations of the photocathodes.

Apple Pectin Based Hydrogel Electrolyte for Energy Storage Application

Nora Chelfouh, Gaël Coquil, Steeve Rousselot, Elsa Briqualeur, Gabrielle Foran, Mickaël Dollé

Université de Montréal

With the increase of portable power sources demand, new technologies, e.g. wearable and flexible electronics, are projected to generate \$1.25 billion market by 2022. New storage energy devices are more than ever in demand which requires new specifications in order to be used in those future applications. To achieve this development, we have to minimize the environmental impact in the whole battery life cycle, from conception to degradation of the system, and reduce production costs. Polymer hydrogel electrolyte are one of the promising alternative for processing new flexible batteries. A great hydrogel electrolyte should promise excellent ionic transport pathways and sufficient mechanical strength, not to cause short-circuits. As a matter of fact, hydrogel electrolytes are well-known for their good ionic conductivity. Nevertheless, the original polymers used in these systems don't take into account the cost of the environmental impact and safety due to the processing or biodegradability of those hydrogels.

In this study, we report a new hydrogel-based electrolyte material made by apple pectin. This presentation will mainly focus on the interactions between pectin functional groups, water and ions using solid NMR spectroscopy. Thermal properties will be discussed based on differential scanning calorimetry analysis. Electrical and electrochemical characteristics obtained by electrochemical impedance spectroscopy, galvanostatic cycling and cyclic voltammetry will demonstrate the applicability of such hydrogel electrolyte.

This study could promote a great innovation in the energy storage field, by recycling one of apple peel's component (which is the main waste in preserves manufacturing) into a hydrogel electrolyte.

Study of The Effect of Zr, Fe and Zr₃Fe Addition on Hydrogen Storage Behavior of Ti₂CrV Alloys

Daniela Bellon Monsalve, Jacques Huot, Alejandro Martínez Amariz

Université du Québec à Trois-Rivières

Hydrogen is an energy carrier; thus, it must be produced and stored. Then, in the energy transition from a fossil economy to a hydrogen economy, the challenges associated with those processes must be solved. Referring to storage, several methods have been studied to develop a safe, reliable, and compact storage system with an acceptable cost. Three well-known systems stand out: compressed gas in high-pressure tanks, liquid hydrogen, and solid-state storage system, where metal hydrides are being considered. In the case of metal hydrides, these have been attractive materials for hydrogen storage, due to their high volumetric densities, safety, low cost, no toxicity emission, good absorption, and desorption capacities. However, their applicability is limited by their low gravimetric hydrogen density, absorption kinetics, cycle life, non-reversibility, and activation procedures.

Ti-Cr-V alloys have been investigated extensively due to their high hydrogen storage capacity at moderate working temperatures and under low hydrogen pressure. However, the reversible capacity is lower due to the low plateau pressure of the monohydride and shows a long incubation time during their first hydrogenation. Ti₂CrV alloy has the maximum hydrogen absorption capacity in the Ti-Cr-V series alloy. However, it has a low reversible storage capacity due to its stable dihydride.

The present research aims to investigate the effect on the crystal structure, microstructure, and first hydrogenation behavior of adding Zr, Fe, and Zr₃Fe to the Ti₂CrV alloy. In this work, three different compositions are investigated. The compositions were synthesized by arc melting. The powder was characterized by X-ray and SEM techniques, and its first hydrogenation properties were tested. The so far results showed that when 6%, 8%, and 10% of Zr₃Fe are added to the alloy, the activation is improved not only in terms of hydrogen storage capacity but also in kinetics, and avoids pre-heat treatment.

4. Présentations par affiche/Poster presentations

Auto-assemblage Moléculaire

- 1) Adja Akre Anne Simone - Development of a Hydrophobic Icephobic Epoxy with Potential for Marine and Aerospace Application
- 2) Christophe Lachance-Brais - Tuning DNA Supramolecular Polymers by the Addition of Small, Functionalized Nucleobase Mimics
- 3) Fangzhou Zhao - Arranging Peptide-DNA Conjugates on a Branched DNA Template
- 4) Tyler Brown - Sequence-Programmed DNA Crosslinking Hotspots Create Ultra-Stable Functional Nanomaterials
- 5) Muhammad Ghufuran Rafique - Two-Dimensional Supramolecular Polymerization of Tri-Block DNA Amphiphiles: Sequence: Dependence & DNA-Chromophore Interactions
- 6) Sepideh Kaviani – NA
- 7) Sehrish Khan - Liesegang Patterns of Copper Aspartate Coordination Polymer
- 8) Zahra Alinia - Phase Behavior of 2d Self-Assembled Phosphole-Lipid Films

Développement Durable

- 9) Samir Elouatik - *Laboratory for the Characterization of Materials (LCM)*
- 10) Randa Belkafi - Étude in situ de $Ti_3C_2T_xMXenes$ pour la synthèse électrocatalytique des carburants renouvelables
- 11) Cephas Amoah - Electrochromic Properties of Anthraquinone-Based Molecules : An Experimental and Theoretical Studies

Biomédical

- 12) Jathavan Asohan - Developing Amphiphilic DNA Block Copolymers for Therapeutic Applications in 3D-Cell Culture
- 13) Changyue Du - Quatsomes as Disinfectant Alternatives for Bacterial Biofilms
- 14) Samila Leon Chaviano - Contrast-Enhanced Hydrogel as Cell Scaffold for Tissue Implantation MRI Tracking
- 15) Mahdokht Akbari Taemeh - Physicochemical Study of Radiochromic Gel Behaviour Upon Exposure to Light and Oxygen
- 16) Souheib Zekraoui - Development of Anatomically Relevant Brachytherapy Implants of Complex Shapes Optimized for the Treatment of Uveal Melanoma

17) Zongyi Liu - Development of a 3D-bioprinted Cancer Cell Architecture with Application on the Chick Chorioallantoic Membrane (CAM)

Nanosciences

18) Yuanjiao Li - Oil-Immersed Scanning Electrochemical Cell Microscopy

19) Patricia Moraille - *Scanning Probe Microscopy (SPM) at the Laboratory of Characterization of Materials (LCM)*

20) Adryanne Clermont-Paquette - An investigation of the Behavior and Localization of Fluorescent Carbon Dots in Live Human Cells

21) Jacob Hui - Double Perovskite Nanocrystals

Polymères

22) Nicolas Macia - Laboratoire de caractérisation des matériaux polymère (LCMP)

23) Son Bui - A DNA-Encoded Library Design Enables High-Throughput Screening of Aptamer-Like Sequence-Defined Oligomers

24) Hui Wen Yong - Tertiary Amine: A Superhero in Soft Nanoparticle Based Drug Delivery

25) Ilies Seddiki - Self-Healable Elastomers by Component Exchange

Énergie

26) Gregory Amato - Making Triboelectric Nanogenerators (TEGs) Accessible

27) Aaron Gabriel Nunez Avila – ATPH - AGNA

28) Samaneh Salek - Photoelectrochemistry and Electrochemical Impedance Spectroscopy of Electrodeposited Methylammonium Lead Iodide (MAPbI₃) and Cesium Lead Bromide (CsPbBr₃) Perovskites

29) Caroline Bergeron - Development of Solar-Powered Biohybrid Systems for the Production of Ammonia

30) Marc Bertrand - Assembling an All-Solid-State Ceramic Battery: Assessment of Chemical and Thermal Compatibility of Solid Ceramic Electrolytes and Active Material using High Temperature X-ray Diffraction

31) Gabrielle Foran - Determination of Lithium Transport Mechanism in Ceramic-Solvate Ionic Liquid Hybrid Electrolytes via Exchange NMR Spectroscopy

5. Atelier sur l'art de l'entrevue et de la négociation en embauche/Workshop on the art of interviews and negotiation at hiring - Gad Sabbatier

Un entretien d'embauche requiert préparation, patience et proactivité. Cet atelier discute du processus de recrutement, des questions les plus courantes, des stratégies de réponse et des tactiques de préparation afin de vous mettre dans les meilleures conditions pour se faire offrir un emploi d'impact. Une fois une offre d'emploi proposée, la plupart des candidats ne négocient pas tandis qu'il est prévu de le faire. Les participants à l'atelier comprendront comment fonctionne la négociation à l'embauche et comment tirer le meilleur parti de cette négociation.

-

A job interview requires preparation, patience and proactivity. This workshop discusses the recruitment process, common questions, response strategies and preparation tactics to put you in the best possible position to be offered an impactful job. Once a job is offered, most candidates do not negotiate while it is expected to do so. Workshop participants will understand how hiring negotiation works and how to get the most out of this negotiation.