



Nanotechnology Engineering Symposium

Friday, March 21, 2014, 9:30am to 6:00pm, at the William G. Davis
Computer Research Centre

Project Presentations

| I. Nano Fluidics & Biotechnology | | Room |
|---|--|--------------------|
| <i>Time</i> | <i>Project Title, Design Group</i> | <i>Project No.</i> |
| 9:40 | Physical Adhesives for Band-Aids <i>Aaron Au, Bin Hyun, HoJae Cheang, Peter Son</i> | NE_2014_01 |
| 10:00 | Quantum Aptasensor <i>Madelaine Liddy, Nupur Maheshwari, Wesley Olsen, Hemil Patel</i> | NE_2014_08 |
| 10:20 | Quantitative Antigen Detection Using Fluorescence Quenching Competitive Immunoassay <i>Robert Ho, Armen Tchobanian, Hans Bernard Tee, Wesley Tetlock</i> | NE_2014_12 |
| 10:40 | Nanofluid-Enhanced Electronics Cooling <i>John Brand, Vance Nguyen, Oleksiy Struk, Andy Zhou</i> | NE_2014_15 |
| 11:00 | Sierra: The Next Generation Biosensor <i>Alison Lee, Chelsea Marr, Krishna Iyer</i> | NE_2014_19 |
| II. Nano-Electronics & Photonics | | DC-1302 |
| <i>Time</i> | <i>Project Title, Design Group</i> | <i>Project No.</i> |
| 11:30 | Miniature, Flexible Tracking Devices <i>Austin Jiao, Dusan Sarenac, Garry Ng, Max Palumbo</i> | NE_2014_03 |
| 11:50 | Thin, Flexible and Transparent Carbon Nanotube Loudspeakers <i>Daniel Challadurai, Nolan Lassaline, Paul Morin, Lisa Belbeck</i> | NE_2014_04 |
| 12:10 | Inner Pixel Photovoltaic Cells for Displays <i>Ammar Masud, Rohit George John, Shazib Mahmood, Teja Manabotula</i> | NE_2014_06 |
| 12:30 | Papyrus Magnetica: Magnetic Colour Paper <i>J. Kenji Clark, Vernon Elmo Paul, Takayuki Fukada, Wenhan Liu, Allen Zhou</i> | NE_2014_11 |
| 12:50 | Carbon Nanotube-Enhanced Aerogel for Lithium Ion Batteries <i>Andrew Boodhoo, Jackson Ellard, Megan Farrell, Chrisford Ling</i> | NE_2014_16 |

| III. Nano Functional Materials - Session I | | Room DC-1302 |
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| <i>Time</i> | <i>Project Title, Design Group</i> | <i>Project No.</i> |
|-------------|---|--------------------|
| 1:30 | Thermal Insulation Enhancement with Nanofiber Incorporation <i>Abbas Abdel Wahab, Derek Wing Sing Cheng, Jonathan Dos Santos, William Wai Lam Chung</i> | NE_2014_02 |
| 1:50 | PASCAL: Pressure-Actuation Stimulated Chromodynamic Active Layer <i>Isobel Bicket, Joshua Cantin, Chun Yuen Kwok, Shirley Ma, Won Kyu Calvin Sun</i> | NE_2014_05 |
| 2:10 | Capacitive Deionization Electrodes <i>Ahmed Abdelaal, Andy Wang, Joseph Bteich, Mohamed Aborg</i> | NE_2014_07 |
| 2:30 | Thermally Active Reflective Roof Coating <i>Lindsay Brock, Ioana Craiciu, Yik Tung Roy Lee, Farzana Yusufali</i> | NE_2014_09 |
| 2:50 | Magnetic Nanocomposite for Wastewater Treatment <i>Anjali Gopal, Stuart Linley, R. David Evans, Dushanth Seevaratnam</i> | NE_2014_10 |

| III. Nano Functional Materials - Session II | | DC-1331 |
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| <i>Time</i> | <i>Project Title, Design Group</i> | <i>Project No.</i> |
|-------------|---|--------------------|
| 3:30 | Crystalline Nanocellulose-Reinforced Paper for Speaker Design <i>Alexander Baran-Harper, Tyler Davidson-Hall, Kevin Joseph, Timothy Stork</i> | NE_2014_13 |
| 3:50 | Capacitive Touch-Screen Compatible Nanocomposite for Gloves <i>Philippe Audette, Geoffrey Hopkins, Kaitlynd Burns</i> | NE_2014_14 |
| 4:10 | Inexpensive Antireflective Passivated Solution <i>George Baxter, Benjamin Greenlay, Matthew Haines, Michael Leung, Elwin Ha</i> | NE_2014_17 |
| 4:30 | Mesoporous Silica for Novel Human Hair Dye <i>Savannah Copland, Philippe Schwyter, Nathan Murnaghan, Ricky Tjandra</i> | NE_2014_18 |
| 4:50 | The Perfect Dress Shirt <i>Firas El-Hamed, Saleh Jidawwi, Mehmet Murat Kiy, Omer Mullick</i> | NE_2014_20 |
| 5:10 | Super Oleophobic Surfaces for Touch Screen Devices <i>Saeed Farshchi, Mustansir Khowaja, Sangeeth Srinivasan, Joel Thomson</i> | NE_2014_21 |

Project Abstracts

I. Nano Fluidics & Biotechnology

Project No. Project Title, Design Group, Abstract

NE_2014_01 **Physical Adhesives for Band-Aids**

Aaron Au, Bin Hyun, HoJae Cheang, Peter Son

A patch is being developed that can adhere to skin by anchoring the patch to the epidermis layer of the skin. It is designed to protect large shallow wounds that band-aids cannot cover. The product brings additional advantages, like water barrier properties and adhesion even when the surface is wet.

NE_2014_08 **Quantum Aptasensor**

Madelaine Liddy, Nupur Maheshwari, Wesley Olsen, Hemil Patel

Who knew that diamonds were useful for more than just engagement rings? Our group is fabricating a DNA biosensor using aptamers (single stranded DNA) functionalized to a diamond surface, rich with nitrogen vacancy centres for detecting small molecules. The device can optically detect magnetic field changes in the nitrogen vacancy centres of the diamond brought on by the presence of the target molecule. The biosensor features both high sensitivity and specificity towards the target, and is capable of providing an instantaneous detection signal in a unique compact design.

NE_2014_12 **Quantitative Antigen Detection Using Fluorescence Quenching Competitive Immunoassay**

Robert Ho, Armen Tchobanian, Hans Bernard Tee, Wesley Tetlock

Malaria is a disease of unfortunate notoriety that shares symptoms with many common ailments. This is a particularly problematic issue in less privileged countries, since the available diagnostic tests not reliant upon specialized equipment and expertise can be unreliable and qualitative. This project strives to address this predicament by developing a simple, accurate test that takes advantage of the properties of gold nanoparticles, using them in a fluorescence quenching competitive immunoassay system. When a sample containing the analyte is introduced to the system, it will fluoresce with intensity corresponding to the concentration, allowing for quantitative diagnosis.

NE_2014_15 **Nanofluid-Enhanced Electronics Cooling**

John Brand, Vance Nguyen, Oleksiy Struk, Andy Zhou

By exploiting unique properties of nanoparticles we have engineered a novel coolant fluid that allows operation of high-performance electronics at lower temperatures than is possible with current cooling systems. Our innovative approach to liquid cooling has far-reaching applications in areas including, but not limited to personal computers, servers, lasers and air conditioning systems. We demonstrate the benefit of using the nanofluid in a common office computer by reducing its operating CPU temperature.

NE_2014_19 **Sierra: The Next Generation Biosensor**

Alison Lee, Chelsea Marr, Krishna Iyer

Our innovative sensor combines fibre optics and LEDs with gold nanoparticles to create a novel biosensor. Our sensor uses the interaction of light around nanoparticles to detect the concentration of certain molecules in a solution. Unlike today's expensive biosensors, our design offers a versatile product with rapid performance that anyone can use anywhere. It has huge commercial potential in medical diagnostics, drug discovery, and environmental monitoring.

II. Nano-Electronics & Photonics

Project No. Project Title, Design Group, Abstract

NE_2014_03 **Miniature, Flexible Tracking Devices**

Austin Jiao, Dusan Sarenac, Garry Ng, Max Palumbo

A fully integrated tracking device on a miniature flexible platform, incorporating GPS and cellular communications technologies, provides a convenient, inconspicuous, and compact package for the reliable tracking of items of various sizes. This result is geared towards the production and improvement of security and stealth tracking technologies that would be easily accessible to both mature industries and the general public.

NE_2014_04 **Thin, Flexible and Transparent Carbon Nanotube Loudspeakers**

Daniel Challadurai, Nolan Lassaline, Paul Morin, Lisa Belbeck

The future of sound technology is here, and it is more flexible than ever. Carbon nanotube speakers generate sound using heat fluctuations, unlike conventional speakers that use moving parts. The advantages are numerous: it is thinner than paper, transparent, and can be bended, twisted and stretched without any changes to the sound. Future applications include curved displays, wearable electronics, and transparent devices.

NE_2014_06 **Inner Pixel Photovoltaic Cells for Displays**

Ammar Masud, Rohit George John, Shazib Mahmood, Teja Manabotula

The aim of this project is to design inter pixel photovoltaic cells that would allow us to harness a portion of the ambient light exposed to the display panel of a mobile device. This design helps to extend the operational time of the mobile device on a single charge by helping to reduce power consumption from the battery. The photovoltaic cells will primarily be used to power the display of the device, and when the display is not active it will charge the battery of the device. Efficiency of the photovoltaic setup is to be maximized while keeping the fabrication costs to a minimum to allow integration of this technology into large-scale production of mobile units. The technology can also be scaled to other devices that utilize OLED displays.

NE_2014_11 **Papyrus Magnetica: Magnetic Colour Paper**

J. Kenji Clark, Vernon Elmo Paul, Takayuki Fukada, Wenhan Liu, Allen Zhou

Inspired by nanotechnology principles found in nature, Papyrus Magnetica uses the power of magnets to revolutionize the way you store and display information. Control magnetic fields to record your ideas in a spectrum of colours on the display, all without the use of battery power. Designed with reusability and low energy consumption in mind, Papyrus Magnetica is an environmentally-friendly alternative to paper and electronic tablets. Paper, reinvented.

NE_2014_16 **Carbon Nanotube-Enhanced Aerogel for Lithium Ion Batteries**

Andrew Boodhoo, Jackson Ellard, Megan Farrell, Chrisford Ling

Lithium ion batteries have become benchmark technology due to their high charge capacity. Increasing their charge rate and charge would allow rechargeable power to better meet the demands of electric vehicle manufacturers. We target the graphite anode currently used in lithium ion batteries for replacement with a novel carbon nanotube aerogel anode boasting high specific surface area; by increasing the specific anode lithium loading capacity, as well as the surface available mass, we hope to boost the specific energy and charge rate of the battery.

III. Nano Functional Materials

Project No. Project Title, Design Group, Abstract

NE_2014_02 **Thermal Insulation Enhancement with Nanofiber Incorporation**

Abbas Abdel Wahab, Derek Wing Sing Cheng, Jonathan Dos Santos, William Wai Lam Chung

Inspired by the simplicity and effectiveness of nature's best insulation, goose down, we incorporated nanofibers into traditional insulation material to enhance the ability to resist extreme temperatures. This enhancement method can be applied to virtually any type of high-loft insulation which would significantly impact the way high-loft insulation is manufactured and applied today.

NE_2014_05 **PASCAL: Pressure-Actuation Stimulated Chromodynamic Active Layer**

Isobel Bicket, Joshua Cantin, Chun Yuen Kwok, Shirley Ma, Won Kyu Calvin Sun

Colour adds beauty to nature's creations, but also serves a vital purpose: flowers use colour to attract pollinators and many animals use it to attract their mates. We combine nanotechnology with the beauty of colour to produce a patch responsive to changes in environmental pressure, suitable for the recreational swimmer or diver. This elastic material, containing a crystalline array of tiny spherical voids, will reflect different colours depending on the pressure applied, whether from the press of a finger or the water pressure encountered during a dive.

NE_2014_07 **Capacitive Deionization Electrodes**

Ahmed Abdelaal, Andy Wang, Joseph Bteich, Mohamed Aborg

According to a 2007 World Health Organization report, 1.1 billion people lack access to an improved drinking water supply. An upcoming method of water desalination called capacitive deionization, CDI for short, has shown promise in the removal of low salt concentrations at lower energy when contrasted to other current technologies. Upon applying a potential difference across two porous electrodes, ions are temporarily immobilized and removed, resulting in an improved water supply. Our proposed nanocomposite material hopes to achieve higher throughput which will allow CDI to become a competitive technology in water treatment.

NE_2014_09 **Thermally Active Reflective Roof Coating**

Lindsay Brock, Ioana Craiciu, Yik Tung Roy Lee, Farzana Yusufali

In the fight to lower energy consumption, a change as small as switching from incandescent to fluorescent light bulbs can make a big difference. In fact, we've already made that transition. So what comes next? Using basic material properties and clever engineering, our team has developed an energy saving roof coating designed specifically for Canadian-like climates. Capable of reflecting or transmitting heat depending on the season, our coating works to reduce the energy required to control room temperature, thereby saving the environment and your money at the same time.

NE_2014_10 **Magnetic Nanocomposite for Wastewater Treatment**

Anjali Gopal, Stuart Linley, R. David Evans, Dushanth Seevaratnam

Industrial pollution arising from chemical production and petroleum processing is a growing environmental concern within the wastewater sector, and removal of these contaminants presents a multi-billion dollar problem. Traditional treatments are incapable of addressing these hazardous molecular contaminants, and current nanoparticle-based approaches encounter recovery issues, which reduces cost effectiveness. A novel approach to treating organic contamination utilizes a photocatalytic titanium-dioxide and magnetic iron oxide nanocomposite embedded in a graphene base. The use of such a nanocomposite results in a wastewater treatment solution that is recyclable, non-toxic, and highly cost-effective.

NE_2014_13

Crystalline Nanocellulose-Reinforced Paper for Speaker Design

Alexander Baran-Harper, Tyler Davidson-Hall, Kevin Joseph, Timothy Stork

Crystalline Nanocellulose (CNC) is a novel green material with mechanical properties rivaling those of Kevlar. Cellulose paper has long been used in the production of loudspeaker cones as it yields desirable acoustic properties. By implementing CNC into a paper composite, we hope to achieve superior mechanical properties without compromising audio quality, allowing for thinner, lighter speaker cones and a significant reduction in speaker driver cost.

NE_2014_14

Capacitive Touch-Screen Compatible Nanocomposite for Gloves

Philippe Audette, Geoffrey Hopkins, Kaitlynd Burns

Stay connected in the winter while wearing your favourite gloves by making them compatible with all your touch screen devices. Using a rapid process compatible with most types of glove fabric, a unique nanocomposite is applied to gloves, keeping your digits warm and allowing you to use your touch screen as if the gloves were not there. This polymer-based nanocomposite keeps your fingers warmer and is less noticeable than current market solutions.

NE_2014_17

Inexpensive Antireflective Passivated Solution

George Baxter, Benjamin Greenlay, Matthew Haines, Michael Leung, Elwin Ha

Randomly distributed nanostructures are able to decrease reflection, and hence increase transmission of incoming light. However, the principal drawback is these structures are extremely fragile. We propose a solution that involves the combination of nanostructures with an anti-reflective protective layer. The result will be an inexpensive antireflective system with superior transmittance and increased lifetime. This is applicable for electronic displays, glasses, and lenses for cameras and telescopes.

NE_2014_18

Mesoporous Silica for Novel Human Hair Dye

Savannah Copland, Philippe Schwyter, Nathan Murnaghan, Ricky Tjandra

The Chromalia group is developing their flagship technology, Chromapearls™, which stand to disrupt the cosmetics industry as a novel colour templating system. Chromapearls™ are mesoporous silica particles, which can be filled with a variety of compatible dyes. The particles, due to their nano dimensions, can diffuse into human hair and provide a striking colour change. The Chromapearl™ dye is a safer and milder alternative to conventional oxidation dyes, as the non-toxic and non-reactive pearls keep skin safe from irritating chemical additives. The treatment is also less damaging, leaving hair healthy and strong even after multiple colourings.

NE_2014_20

The Perfect Dress Shirt

Firas El-Hamed, Saleh Jidawwi, Mehmet Murat Kiy, Omer Mullick

Look sharp and feel fresh. Our goal is to make the most comfortable dress shirt possible. Right now clothing is too static, refusing to adapt to the wearer's environment. How stubborn. We sought to change it. With our technology, your body always stays cool, even when exploring the vast endlessness of the Saharan desert. Sweating? No Problem! Moisture on your skin is wicked away through tiny channels in the shirt. Free yourself from embarrassing sweat stains! The cherry on top: integrated silver nanowires kill bacteria. Your shirt will always be odour- and stain-free, keeping you confident and looking the best you possibly can.

Super Oleophobic Surfaces for Touch Screen Devices

Saeed Farshchi, Mustansir Khowaja, Sangeeth Srinivasan, Joel Thomson

Touch screen devices exemplify a rapidly advancing revolution in technology of the 21st century. A common concern for these however is that they are highly susceptible to attracting fingerprints and dirt which in turn depreciates the sensitivity, functionality, and visibility of the screen. Current technologies include spray coating – which takes time to take effect as well as repeat applications – or sticking on an additional plastic layer which is tedious, sometimes inducing air bubbles in the interface. As part of our final year undergraduate design project - we hope to engineer a surface with built-in super-oleophobic capability by utilizing nanotechnology based design methodology in conjunction with low surface energy materials to achieve a robust and durable, anti-smudge, self-cleaning surface.
