

Department of Chemical Engineering

Seminar

Thursday, April 18, 2013

3:30PM – E6 2024

“Surface Engineering of Renewable Materials Based on Nanocellulose”

Dr. Emily D. Cranston

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

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 nanocellulose-based materials. The term “nanocellulose” refers to both 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. Nanocellulose shows great promise as a composite component because of its 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 nanocellulose, 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.

Education

B.Sc. Chemistry, McGill University (2001)

Ph.D. Materials Chemistry, McGill University (2008)

Post-Doctoral Associate, Royal Institute of Technology,
Stockholm, Sweden (2010)

Brief Biography

Emily was born in Halifax, Nova Scotia and moved to Montreal, Quebec following her completion of high school. She received her Honours B.Sc degree in Chemistry with a specialty in Bio-Organic Chemistry from McGill University. During her undergraduate studies she participated in research focused on natural and synthetic biodegradable polymers and was involved with establishing the Canadian Green Chemistry and Engineering Network. During this time she also worked on developing multimedia tools for teaching Chemistry and Physics and worked full-time writing software after graduation. She then went on to graduate studies in the group of Professor Derek Gray at McGill University, obtaining a Ph.D. in Material Chemistry (within the Pulp and Paper Research Centre). Her thesis entitled "Polyelectrolyte Multilayers Containing Cellulose Nanocrystals" explored the use of nanocrystalline cellulose for model surfaces and in novel cellulose composites. The study of "value-added" products from cellulose took her to Stockholm, Sweden (they also have a lot of trees!) where she worked as a postdoctoral researcher in two departments: Surface and Corrosion Science (mastering techniques to characterize surface forces and adsorption phenomena) and Fibre and Polymer Technology (looking at fundamental and mechanical properties of nanocellulose). During her stay in Sweden she also acted as the Coordinator for one theme of Biomine, the Swedish Centre for Biomimetic Fibre Engineering; Fundamentals of Adhesion and Composite Technology. Incidentally, Emily got to travel to twelve countries in Europe, Africa and North America over her two years in Sweden – this meant eating lots of delicious new food and meeting some fabulous new people. In January 2011 she took up the position of Assistant Professor in Chemical Engineering at McMaster University where her research focuses on surface engineering of sustainable materials based on nanocellulose.