Department of Electrical and Computer Engineering
Materials Engineering Program
Center for Integrated Bio and Nano Systems
10:30 a.m., Jan. 29, 2021

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Development and applications of multifunctional polymer composites based on carbon and boron nitride nanotubes

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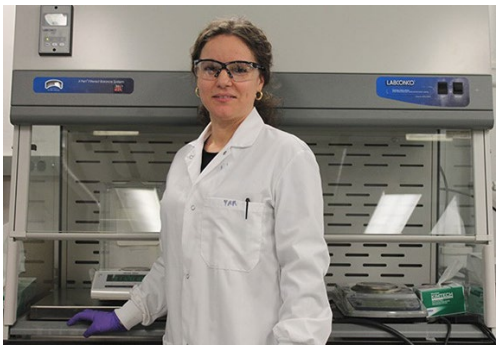
Abstract: One-dimensional nanomaterials such as carbon nanotubes (CNTs) and boron nitride nanotubes (BNNTs) possess impressive physical, chemical and mechanical properties and are promising reinforcements for the development of advanced composite materials. BNNTs and CNTs, however, offer different multifunctional characteristics; CNTs are electrically conductive while BNNTs possess superb resistance to oxidation, a wide energy band gap, transparency in the visible region, and high neutron absorption cross section. Historically, very low production volume has prevented the science and technology of BNNTs from evolving at even a fraction of the pace of CNTs. We have addressed this limitation through the development of an industrially scalable plasma process for the manufacturing of BNNT. Using an integrated approach to advanced materials development, we are also addressing the challenges associated with exploitation of nanomaterials¬ - from nanotube (NT) purification and quality assessment to the development of integration methods for diverse matrices. I will present our recent advances in BNNT purification and the development of a method for quality (purity + defect density) assessment of bulk samples, an area that has plagued the field of carbon nanotubes for more than 30 years. The integration of high NT content into polymer matrices can be challenging but is often necessary in order to achieve mechanical, thermal or electrical conductivity requirements for a particular application. I will highlight our recently developed process for the direct fabrication of high-content NT-thermoplastic polyurethane (TPU) composite sheets that circumvent most of the limitations of previous methods and can also be applied to other polymer matrices. The method is based on controlled adsorption of the polymer on the surface of NTs and allows for compositional control and optimization of properties. The developed fabric-based composites, inspired and combined with conventional composites layup methods, have been evaluated to improve impact energy adsorption and flame resistance, as adhesives for ceramic armor, and as the basis for the skin of a stretchable morphing aircraft wing design.



Short Bio: Dr. Yadienka Martinez-Rubi is a Research Officer in the Emerging Technologies Division at the National Research Council Canada (NRC). She received an undergraduate and Master's degree in Chemistry from University of Havana, and a Ph.D. in Chemistry from the University of Chile on the topic of hybrid organo-inorganic functional material. She first joined the NRC as an NSERC postdoctoral fellow and presently holds the position of Research Officer. She has continued working in the area of nanotechnology and materials science addressing the challenges associated with exploitation of nanomaterials. Ongoing projects focus on chemical modification and integration of nanomaterials, in particular carbon nanotubes (CNTs) and boron nitride nanotubes (BNNTs) but also other nanocarbons and bio-nanofibers with the purpose of producing multifunctional composites (e.g., nanocomposites, hierarchical composites), nanocomposite fabrics, responsive materials, and coatings for applications in defense, aerospace and other sectors. Her work at NRC has also been recognized by several awards, including two awards for demonstration of nanocomposites applications. She has published over 70 peer-reviewed papers with a total of over 1000 citations, and 6 patents and patent applications.

Please contact Dr. Francisco Robles Hernandez <fcrobles@Central.UH.EDU> or Jiming Bao (jbao@uh.edu) if you want to meet with the speaker.