



Nanotechnology Seminar, Wednesday 29.4.2015, 12:00

IKI Auditorium, Building 51, room 015

Multifunctional Multilayer Nanocoatings Capable of Separating Gases, Killing Bacteria and Stopping Fire

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Abstract:

Layer-by-layer (LbL) assembly is wide-reaching conformal coating “platform” technology capable of imparting a multiplicity of functionalities on nearly any type of surface in a relatively environmentally friendly way. At its core, LbL is a solution deposition technique in which layers of cationic and anionic materials (e.g. colloidal or nano-particles, polymers and even biological molecules) are built up via electrostatic attractions in an alternating fashion, while controlling process variables such as pH, coating time, and concentration. Here we are producing nanocomposite multilayers having 10 – 96 wt% clay that are completely transparent and exhibit oxygen transmission rates below 0.005 cm³/m²•day (at a film thickness below 100 nm). These same ‘nanobrick wall’ assemblies are very conformal and able to impart flame resistance to highly flammable foam and fabric by uniformly coating the complex three-dimensional geometries. On foam, these coatings can dramatically reduce the heat release rate (HRR) and eliminate melt dripping. We’ve also developed intumescent recipes that do not require clay, but rather rely on the foaming action of phosphorus and nitrogen-rich molecules. I’ll also describe how these films can separate H₂ from N₂, with selectivity greater than 2000, which exceeds other commonly used gas separation membranes (including zeolites). These films also have exceptional oxygen barrier that makes them interesting for food and flexible electronics packaging. These films can also be produced with graphene oxide to generate high barrier and low sheet resistance. All of the materials described are water-based and processing occurs under ambient conditions in most cases. I’ll also describe how these nanocoatings can be deposited in a commercially-feasible manner. Our work in these areas has been highlighted in C&EN, ScienceNews, Nature, Smithsonian Magazine, Chemistry World and various scientific news outlets worldwide. For more information:

<http://nanocomposites.tamu.edu>

The Speaker

Dr. Jaime Grunlan joined Texas A&M University as an Assistant Professor of Mechanical Engineering in July of 2004, after spending three years at the Avery Research Center in Pasadena, CA as a Senior Research Engineer. He obtained a B.S. in Chemistry, with a Polymers & Coatings emphasis, from North Dakota State University and a Ph.D. from the University of Minnesota in Materials Science and Engineering. Prof. Grunlan was promoted to Associate Professor in 2010 and then Professor in 2014. His research focuses on thermal and transport properties of nanocomposite materials, especially in the areas of thermoelectric energy generation, gas barrier and fire prevention. He won the NSF CAREER and 3M Untenured Faculty awards in 2007, the Dow 2009 Young Faculty Award, the 2010 Carl A. Dahlquist Award, the 2012 L.E. Scriven Young Investigator Award, sponsored by the ISCST, and the 2013 E. D. Brockett Professorship for his work in these areas. He has published over 100 journal papers and filed several patents. His current research group consists of 3 postdocs, 11 PhD candidates and 16 undergraduate researchers. Dr. Grunlan also holds joint appointments in Chemistry and Materials Science and Engineering.