Topic: **Molecular Structure Transformations and the Kinetics of Carbon Nanomaterial Formation**

Speaker: **Dr Gyula Eres**
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Date: **26 September 2013, Thursday**

Time: **2.00pm to 3.00pm**

Venue: **E3-06-07** *(map of NUS can be found at http://map.nus.edu.sg/)*

Host: **Dr. Duong Hai Minh**

Abstract

Carbon nanomaterial synthesis is typically performed at extreme temperatures and pressures that occur in plasmas or flames. During their relaxation the highly non-equilibrium reactive carbon species are trapped in a succession of metastable states corresponding to a broad range of products. The distribution of products is an intrinsic property of the carbon transformation reactions that occur by rearrangements of carbon-carbon bonding configurations during self-assembly from energetically unstable species. Consequently, these distributions are governed by kinetic rather than by thermodynamic constraints. This approach is highly effective in the exploratory phase of research because the desired structures can be isolated and purified for further characterization using chemical separation techniques. However, this approach is impractical for mass production of carbon nanomaterials that is needed for applications.

The complexity of these processes is well recognized and the obstacles to synthesis of carbon nanomaterials with desired structure are related to the poor understanding of the barriers and the reaction pathways connecting initial molecular structures to final products. Controlling the assembly of carbon at the molecular level is the most promising avenue for unlocking the secrets of carbon nanomaterial synthesis. The focus of this talk is on chemical vapor deposition processes that occur at milder conditions promising greater control over the product distribution in the formation of carbon nanotubes and graphene. For controlling the reaction conditions we use a molecular beam environment to suppress secondary gas phase reactions and restrict the growth to heterogeneous surface reactions of specific molecular precursors on a single collision level such as acetylene. The carbon deposition kinetics is studied in real-time using time-resolved optical reflectivity methods. Growth kinetics data alone are insufficient to determine the exact reaction mechanisms, but they allow identification of a particular reaction class with a characteristic product distribution that is critical for obtaining carbon nanomaterials with desired properties.

About the Speaker

Dr. Gyula Eres is a senior research staff member in the Materials Science and Technology Division of Oak Ridge National Laboratory, US. He holds a Ph.D. in chemical physics from the University of Illinois at Urbana-Champaign. His current research is focused on understanding the mechanisms and the kinetics of elementary surface processes that control the synthesis and properties of interfaces in epitaxial thin films, superlattices, and nanostructured materials relevant for advanced energy applications. The experimental approach combines energy enhanced and nonequilibrium growth techniques including pulsed laser deposition and supersonic molecular beam epitaxy with in situ time-resolved imaging, diffraction, and spectroscopic techniques such as surface x-ray diffraction, laser based optical diagnostics, mass spectrometry, and reflection high energy electron diffraction.

Admission is free. All are welcome to attend.