Seminar Series

School of Materials Science and Engineering

Thursday, April 16, 2009

5:00 PM – Room 200 Olin Hall

Measurement of the refractive index of chalcogenide thin films using prism coupling in the near and mid-infrared.

Nathan Carlie

Chalcogenide glasses (ChGs) are well suited for mid-infrared (3-12 microns) photonic component designs due to their high transparency and their amenability for processing into thin films. ChG waveguide structures have been fabricated through various techniques, such as lithography, embossing, and etching, or through direct laser writing by leveraging their sensitivity to near and sub-band gap illumination. Direct laser writing provides a rapid and flexible method of waveguide component fabrication; however, device designs and performance simulations depend critically on precise knowledge of the thin film refractive index and the change in the index induced by post-deposition processing. Common spectroscopic and ellipsometric techniques for refractive index determination generally offer either precision that is too low, or lack the ability to provide information about index dispersion. In order to overcome these deficiencies, a commercial instrument (Metricon model 2010) has been modified to measure the refractive index of thin films over the near and mid-infrared spectral regions with a typical index accuracy $5x10^{-4}$. We present the instrumental configuration and initial refractive index measurements of ChG thin film materials over the 1.5 to 10.6 μm wavelength range. The index dispersion of bulk As_2Se_3 and as-deposited, annealed, and photomodified thin film materials are presented and the processing-induced index variations are discussed. Such measurements allow a new potential for thin film-based device optimization and may offer future insights into the photomodification mechanisms of these materials.

N. Carlie, Ph.D. student; Advisor: Kathleen Richardson

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Modification of Advanced Combat Helmet Padding System to Reduce the Penetration of Shock Waves

Katelyn Howay

There have been an increased number of improvised explosive devices (IEDs) being encountered in the current conflict in Iraq. Advancements have been made in the ability of combat helmets to withstand ballistic collisions but have not reduced the number of traumatic brain injuries (TBIs). It is believed that the shock wave caused by an IED can result in a TBI with cellular damage inside the brain. The outer helmet shell is primarily used for ballistic protection, but improvements need to be made to the padding system to reduce the number of TBIs. Currently various fibers and woven materials are being strategically inserted into different types of foam padding to dissipate the shock wave before coming in contact with the wearer's head.

K. Howay, MS Student; Advisor: Christine Cole

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Influence of Hydroxyl Contents on Photocatalytic Activities of Polymorphic Titania Nanoparticles

Sujaree Kaewgun

Polymorphic titania nanoparticles, prepared by a Water-based Ambient Condition Sol (WACS) process, were post-treated by a Solvent-based Ambient Condition Sol (SACS) process in sec-butanol. All samples were characterized for phase composition, surface area, hydroxyl contamination, and particle morphology by x-ray diffraction, N_2 physisorption, FT-IR, solid state Magic Angle Spinning (MAS) ^{1}H NMR and scanning electron microscopy. The results were compared to a commercial titania, Degussa P25. Evaluation of methyl orange degradation under UV irradiation results showed that the lower lattice hydroxyl content in SACS titania nanoparticles enhances their photocatalytic activity. As-prepared titania and post-treated SACS samples, which have similar surface areas and crystallinities, were compared in order to prove that the superior photocatalytic activity came from a reduction in lattice hydroxyl content.

S. Kaewgun, Ph.D. Student; Advisor: Burtrand Lee