



**Seminar Topic:
Light and Thermal Management in Electrochromic Smart Windows for
Building Energy Efficiency**

Associate Professor Alfred Tok ling Yoong

Abstract

More than 50% of solar energy comes from the infrared (IR) region (as radiant heat) of the solar spectrum. Electrochromic (EC) materials, which can dynamically modulate the transmittance of IR radiation, can be effectively applied in smart windows for thermal management in buildings. In this work, a core-shell $\text{TiO}_2\text{-WO}_3$ inverse opal (IO) structure was fabricated through electrodeposition of WO_3 onto TiO_2 IO templates. The TiO_2 IO templates were synthesized by introducing TiO_2 into the voids of a polystyrene (PS) colloidal crystal template, followed by calcination to remove the PS microspheres. It was found that the $\text{TiO}_2\text{-WO}_3$ IO core-shell structure can modulate NIR transmittance at wavelengths from 700 to 1600 nm in the NIR range when potential is applied in a LiClO_4/PC electrolyte. When -0.3 V is applied, up to 60% of NIR radiation in this range can be blocked. The NIR transmittance can be modulated by tuning the applied potential. This study focuses on comparing the novel $\text{TiO}_2\text{-WO}_3$ IO structure with electrodeposited WO_3 thin film to fully elucidate the effect of the IO morphology and the $\text{TiO}_2\text{-WO}_3$ hybrid system on the optical properties. Results show that NIR blockage can be sustained up to 90% after 1200 reversible cycles for the $\text{TiO}_2\text{-WO}_3$ IO structure. The greater surface area of the IO structure increases the number of active sites available for the redox reactions by providing a larger contact area with the electrolyte. The more electroactive area with improved charge transfer enhances the overall NIR transmittance contrast as compared to bulk WO_3 thin film. Furthermore, the addition of WO_3 to TiO_2 to form a composite has been shown to enhance cycling performance and device lifespan

Biography

Dr Alfred Tok ling Yoong (PK; PhD, NTU; C.Eng, MIMMM; MBA, NTU) has been a faculty member in the School of Materials Science and Engineering (MSE) since 2003. He studied Mechanical Engineering at the Queensland University of Technology, Australia, and graduated with First Class Honours in 1995. He was also conferred the Dean's Award for Excellence for being the top graduate. After graduation, he worked as a mechanical engineer at ST Aerospace Engineering. In 1997, he was awarded 2 scholarships at Nanyang Technological University to pursue his PhD in Mechanical Engineering. He obtained his MBA (Dean's List) in 2009 from the Nanyang Business School. In the same year, he was appointed Division Head of Materials Technology in MSE (till 2012). Since 2011, he has been the Deputy Director of the Institute for Sports Research in NTU. His research areas focus on the processing and applications of inorganic materials in the areas of biosensors and renewable / sustainable energy. He also consults extensively for companies from various industries.

Wednesday, 29 August 2018 || Time: 2:00 pm – 3:00 pm
Venue: MSE Meeting Room (N4.1-01-28)
Hosted by: Associate Professor Ali Gilles Tchenguise Miserez