

Seminar

Date: 16 June 2009 (Tuesday)

Time: 11:00 am - 12:00 pm

Venue: EF 305, The Hong Kong Polytechnic University

Surface Science of Lubricious, Hard and Tough Coatings

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Abstract:

Heavily hydrogenated diamond-like carbon films exhibit low-friction behavior when three conditions are satisfied. First, one has to slide these films against each other. Second, the surfaces have to be relatively smooth. Third and most important, the testing environment must have very low levels of humidity. When all three conditions are satisfied, the coefficient of friction can reach as low as 0.001. However, under normal ambient conditions, the coefficient of friction is in the range of 0.05 to 0.1. Our work was focused on solving this moisture sensitivity problem by suppressing water adsorption on these carbon film surfaces. Using sulphur as the surface dopant, we found that the friction coefficient is as low as 0.003-0.008, even in air with 50% relative humidity. This result is consistent with the observation that these sulphur-doped carbon films have a higher water contact angle ($\sim 90^\circ$) than undoped films ($\sim 60^\circ$) and smaller heat of desorption for water vapor.

Although the moisture sensitivity problem has been solved, one seldom-mentioned problem is the relatively low hardness of these films (with or without sulphur), in the range of 10-15 GPa. We have extended the research to the synthesis of multilayer coatings consisting of alternating nanolayers of diamond-like carbon and TiB_2 . The rule of mixtures appears to operate in this system, and the coating hardness can be controlled in a predictable way, while maintaining low friction. Time permitting, I will discuss the final phase of this work, in which we attempt to synthesize coatings that are hard, tough and adherent to the substrate.

Biosketch:

Yip-Wah Chung is Professor of Materials Science and Engineering and Mechanical Engineering at Northwestern University. He obtained his BS and MPhil from the University of Hong Kong and PhD in Physics from the University of California at Berkeley. He has published over 180 papers in surface science, thin films, and tribology, and two textbooks – one on surface science and spectroscopy, and one on introduction to materials science and engineering. He was named Fellow, ASM International; Fellow, AVS; and Fellow, Society of Tribologists and Lubrication Engineers. His other awards include the Innovative Research Award and Best Paper Awards from the ASME Tribology Division, Technical Achievement Award from the National Storage Industry Consortium (now Information Storage Industry Consortium), Bronze Bauhinia Star Medal from the Hong Kong SAR Government, and Advisory Professor from Fudan University. Dr. Chung served two years as program officer in surface engineering and materials design in the Civil and Mechanical Systems Division at the National Science Foundation, acting as the Division representative for the nanoscale science and engineering initiative. He has served many years on the Hong Kong Research Grants Council and is currently a member of the University Grants Committee. He is Director of the NSF Summer Institute on Nanomechanics, Nanomaterials and Micro/Nanomanufacturing. In his spare time, he is often seen doing recreational flying all over the US. In 2003, he earned his commercial multi-engine instrument and advanced ground instructor certificates.

* Refreshment will be served after the seminar.