Purdue University

School of Materials Engineering

Presents

Date: Monday, April 1, 2013

Time: 3:30 Refreshments
3:45 Seminar

Place: ARMS 1010

PURDUE MATERIALS ENGINEERING

Infinite Possibilities

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In-Situ Growth of Nanostructured Thin Film Coatings

ABSTRACT

Coating technology has evolved over the past few years in such a dramatic pace that nanocomposite or nanostructured coatings can now be grown in-situ during deposition processing. These unique nanostructured materials can offer extreme hardness, excellent toughness, erosion-resistance, retention of room temperature properties (after elevated temperature annealing), and high-temperature oxidation resistance, along with other unique properties. The novel nanostructures that enable these properties generally consist of a matrix of ceramic nanocrystals (nc) surrounded by thin layers of amorphous (a) ceramics, which prevent grain growth and grain boundary movement. Coating systems which exhibit this behavior include nc-TiN/a-Si_3N_4 (and SiCN), nc-TiC/a-C, nc-TiBC/a-BN, nc-CrB_2/a-BN, among others. Coating parameter–microstructure–property correlations are presented for selected nanostructured coatings. Challenges with fabricating these unique coating nanostructures with state-of-the-art deposition techniques are discussed. Application of basic material design principles to predict higher-use-temperature coating systems are proposed. Other unique nanostructured coating systems of relevance to photovoltaic conversion are briefly described along with nanomultilayered coatings for high-temperature solid-lubrication and exothermic reactions.

SHORT BIO

Dr. Kustas received his PhD and M.S. from Colorado School of Mines, Department of Metallurgical and Materials Engineering and his B.S. in Mechanical Engineering from University of Colorado, Boulder, CO.

Dr. Kustas has worked in industry for 35 years with a wide variety of company affiliations. Currently, Dr. Kustas is Chief Technical Officer of Engineered Coatings, Inc. (ECI) and NanoCoatings, Inc. (NCI), small companies dedicated to developing and commercializing, respectively, new nanostructured protective thin-film coatings. Emphasis includes cermet, quasicrystalline, nanocomposite, solid-lubricant, and anti-tamper protective thin-film coatings. Applications targeted for these new protective coatings include abrasion/erosion resistance, forming/machining operations, reactive fuses, and superhydrophobic/ice-resistant surfaces.

His prior experience includes Lockheed Martin Space Systems Company, Denver CO as a Senior-Staff Engineer working in the areas of Advanced Aerocapture Technologies, Aerocapture Inflatable Decelerator, DARPA Rapid Eye and transpiration-cooled materials; Group Leader for Wear Sciences and Coatings (WSC) a division of the small company Technology Assessment & Transfer, Annapolis MD. Dr. Kustas was a principal scientist for a small Colorado business, Colorado Engineering Research Laboratory (with Prof. Paul Wilbur of Colorado State University, and Dr. Ronghua Wei) managing contract R&D for the U.S. government and industry for new surface modification technologies and development of ceramic matrix composites.

Dr. Kustas' initial work experience was with Battelle Pacific Northwest Laboratories (B-PNL), Richland WA. During his tenure at B-PNL, Dr. Kustas was a materials engineer involved in corrosion investigations of nuclear reactor system pipe, spent nuclear fuel rods, and modeling of nuclear reactor loss of coolant reactor accidents.

Dr. Kustas has authored over 60 technical papers in advanced coating technology and materials development. In addition, Dr. Kustas has also been awarded 4 patents in advanced materials areas.