Carnegie Mellon
Materials Science and Engineering Seminar Series

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"Functionally Graded Environmental Barrier Coatings"

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10 AM Seminar in Hamerschlag B103

Silicon-based ceramics components in gas turbines require hot-corrosion and recession resistant environmental barrier coatings when exposed to high temperature corrosive environments containing high-pressure steam. It is well established that alpha-alumina coatings, which have excellent hot-corrosion and recession resistance, fail due to poor thermal shock resistance. In contrast, mullite ($3Al_2O_3 \cdot 2SiO_2$) coatings, which have excellent thermal shock resistance and a close coefficient of thermal expansion (CTE) match with the Si-based ceramics, contains silica, which may lead to hot-corrosion and recession attack of the coatings themselves under long term exposures in corrosive environments.

We have grown by chemical vapor deposition (CVD), functionally graded coatings whose composition is varied from stoichiometric mullite at the coating/substrate interface to very aluminia-rich mullite at the coating surface. These mullite coatings exhibited excellent high temperature oxidation, hot corrosion and thermal shock resistance and were very effective in protecting the SiC substrates from corrosive atmospheres.

By varying the gas phase composition during growth, some of the highest alumina-rich mullite reported to date have been deposited. Such ultrahigh Al/Si compositions still retain the mullite structure, but have to accommodate a very high vacancy concentration. The ordering of these vacancies along periodically arranged anti-phase boundaries (APBs) will be discussed.

Soumendra Basu is the Associate Division Head of the Division of Materials Science and Engineering and a Professor of Mechanical Engineering at Boston University. His research interests include thermal barrier and environmental barrier coatings for gas turbine and fuel cell applications; thin films for photonic, electronic, fuel cell and superconducting applications; environmental degradation of materials at elevated temperatures; structure and stability of interfaces; and characterization of structure and phase transformations in materials using electron microscopy techniques. After receiving his PhD in Materials Science and Engineering from MIT, Professor Basu was a Post Doctoral Research Associate at Los Alamos National Laboratory, prior to joining Boston University in 1990. Professor Basu has published close to 100 papers and has presented more than 50 invited talks nationally and internationally. He is the Principal Editor for the book *Surface Engineering 2004 – Fundamentals and Applications.* He has been a consultant to Los Alamos National Laboratory, Praxair-TAFA and RWE Schott Solar on a variety of materials issues. Professor Basu has been a member of Photonics Center at Boston University, and has been on the Organizing/International Advisory Committees of several international conferences.