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APS Colloquium home

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Opportunities for High-Energy X-rays in the Studies of Coatings

Despite the well-known advantages as well as disadvantages of synchrotron-based X-ray diffraction, its application to areas of structural materials science and technology is very much at a nascent stage. One such area that has the potential for both scientific endeavor and technological application is in the area of coatings, in particular for oxidation and thermal protection. Despite languishing for many years, the field of high-temperature oxidation offers particular challenges that, I believe, will require *in situ* observations using hard X-rays in order to make substantial progress in understanding the mechanisms of oxidation as well as how stresses are generated during oxidation. Similarly, *in situ* observations to monitor the microstructural and chemical evolution of thermal barrier coatings are required to understand how damage forms and evolves leading to ultimate failure. Precise, non-destructive measurements can already be made at room temperature so in both cases, *in situ* means making observations in air at near atmospheric pressure and at temperatures in excess of 1000^{o}C. In this talk I will attempt to describe some of the outstanding scientific questions as well as review what is already known about this technologically important field of structural materials.

Dr. David Clarke is currently Professor of Materials at the University of California at Santa Barbara and was Chair of the Materials Department for seven years until stepping down in 1998. Until 1990 he was Senior Manager of the Materials Department at the Thomas J. Watson Laboratory of the Research Division of IBM Corporation having earlier been an Associate Professor of Ceramics at Massachusetts Institute of Technology and Leader of the Structural Ceramics Group at Rockwell International Science Center.

Professor Clarke's research spans both structural and electronic materials, and in recent years has focused on piezoelectric semiconductors (ZnO, GaN and AlN), electronic ceramics and experimental mechanics applied to problems associated with high temperature oxidation of metals and to packaging materials. His research in the area of electronic ceramics has ranged

from the electrical properties of interfaces and grain boundaries to the failure mechanisms in varistor surge arresters.

Professor Clarke's research is internationally recognized. He was elected to the National Academy of Engineering in 1999, to the Academy of Ceramics in 1996 and was elected Fellow of both the American Physical Society (1986) and the American Ceramic Society (1985). In addition, he received the Edward C. Henry Award, Electronics Division, American Ceramic Society (1999); the Sosman Memorial Award, American Ceramic Society (1999); a Doctor of Science, Cambridge University (1996); an Alexander von Humboldt Senior Scientist Award (1992).