



AN HONORS UNIVERSITY IN MARYLAND

Department of Mechanical Engineering

Fall 2006 Seminar Series, Friday- Oct. 27th, ITE 229 at 2:30pm

## **MATERIALS DESIGN FOR BIOMEDICAL APPLICATIONS**

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### **Abstract**

Biomechanics is now a major area of materials research. The mechanics of fracture and other damage modes in engineering ceramic coatings on soft substrates are of special interest because of the potential for premature failures in biomechanical prostheses—dental crowns, hip replacements, etc. In this presentation we characterize contact damage modes in model layer systems that simulate the basic features of biomechanical structures (especially dental crowns), and at the same time allow direct experimental observation of the system responses during loading. We report on different fracture and deformation modes in the ceramic layers, and derive explicit analytical relations for the critical loads required to initiate these competing modes in terms of conventional materials properties (modulus, strength, toughness, hardness) and geometrical variables (layer thickness, contact radius). Particular attention is devoted to radial cracks that initiate within the coating layers—these cracks are believed to a principal cause of clinical failures. Experimental data on selected model bilayers and trilayers are used to validate the relations. Use of the results to provide a sound basis for the design of layer systems with optimal damage thresholds will be discussed.

### **Biographical Sketch**

Brian Lawn gained his B.Sc. and Ph.D. degrees in Physics at the University of Western Australia in 1959 and 1963, respectively. After graduating, he spent four years as a Postdoctoral Fellow in the School of Physics at the University of Bristol and the Department of Engineering and Materials Science at Brown University. From 1968 Dr. Lawn held a professorial position in Applied Physics at the University of New South Wales. During this period he spent several periods of study leave in the Department of Materials Science at the University of Sussex and in the Ceramics Division at the National Institute of Standards and Technology (then the National Bureau of Standards). In 1981 Dr. Lawn joined the National Institute of Standards and Technology permanently, and in 1987 was appointed to the position of NIST Fellow. He has held Adjunct Professor appointments at Lehigh and Carnegie Mellon Universities, the University of Maryland, the University of Western Australia, Curtin University, and Xi'an Jiatong University (China). Dr. Lawn has conducted extensive research on the properties of brittle materials, has published over 270 research papers, and is the author of the book "Fracture of Brittle Solids", now in its second edition. In 2002 he was recognized by the Institute for Scientific Information as "one of the most highly cited, influential researchers in Materials Science" (1981–1999).

In 2001, he was elected a member of the U.S. National Academy of Engineering.

*Refreshments will be served*

Host: Dr. D. Arola