



DEPARTMENT OF MECHANICAL ENGINEERING Purdue School of Engineering and Technology

SPRING 2005 SEMINAR SERIES

Date: **Monday, March 28, 2005**

Time: **10:45 am - 11:45 am**

Room: **SL 165**

Everyone is invited

Micro-Scale Damage and Adhesion Degradation In Thermal Barrier Coating Systems

Dr. Qin Ma

*Research Associate, Department of Mechanical Engineering,
Carnegie Mellon University, Pittsburgh, PA*

Abstract. Thermal barrier coatings are thin ceramic coatings used to insulate gas turbine components. In the as-processed state, TBCs are well-bonded to the metallic substrate they are deposited upon. However, a principal concern with thermal barrier coatings (TBCs) is their loss of adhesion during service, leading to coating spallation. The TBC systems considered in this research consist of a nickel superalloy substrate, a roughly 50 micron thick platinum aluminide bond coat, an alumina layer growing on top of the bond coat having a thickness of 0.25 to 5 microns, and a 100 micron thick yttria-stabilized zirconia TBC. During spallation, debonding typically occurs at or near the alumina/bond coat interface, though in some cases it can also occur within the alumina layer and in the portion of the TBC just above it.

In this presentation, indentation test results are presented measuring loss of interfacial toughness for TBC specimens subjected to isothermal and cyclic thermal exposures at 1100 °C. Results show that the apparent losses of toughness for isothermal and cyclic thermal exposures are comparable. This is despite SEM observations of substantially greater interfacial damage occurring in the specimens subjected to cyclic thermal exposures. To further understand the role of micro-scale damage in the cyclic tests, in-situ measurements of oxide scale residual stress (performed at Oak Ridge National Laboratory) are incorporated into the fracture mechanics models of the indentation tests, as is the presence of cracking within the TBC itself.