



SEMINAR

APPLIED MATHEMATICS AND MECHANICS

FS918

1 June 2017

A DCAMM seminar No. 709 will be presented by

Professor Wen Jin Meng
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The title of the lecture is

**Combined experimentation and simulation on
mechanical failure of metal/ceramic interfacial regions**

Abstract:

We present new experimentation and modeling/simulation results on mechanical integrity of metal/ceramic interfacial regions. Shear failure of the interfacial regions of two ceramic coating / metal adhesion layer/substrate systems, CrN/Cu/Si and CrN/Ti/Si, was measured quantitatively and observed directly through in-situ microscale compression of cylindrical micro-pillars with concurrent electron microscopy observations. Results indicate, for the first time to our knowledge, that shear failure of the interfacial region occurs in two stages: an initial shear deformation of the entire metal interlayer followed by an unstable shear failure close to one metal/ceramic interface.

The experimentally observed unstable shear failure is suggested to be concomitant with the metal/ceramic interface going from being “locked”, with no relative displacement between materials on the two sides of the interface, to being “unlocked”, with significant relative displacements. Density functional theory (DFT) and molecular dynamics (MD) studies on a related, Ti/TiN metal / ceramic interface provided further insights into this behavior.

It was shown, for the first time to our knowledge, that a weak interaction plane exists in the metal layer near the chemical interface in a coherent Ti/TiN structure. Consequently, the free energy as well as the theoretical shear strength of the semicoherent Ti/TiN interface is found to depend on the physical location of the misfit dislocation network (MDN). The minimum energy and strength of the interface occur when the MDN is near, but not at the chemical interface. The movement of this dislocation network as a critical stress level is reached provides a likely physical mechanism through which the unstable interfacial shear failure is achieved. The present results point to means of effective engineering of metal/ceramic interfaces in the future.

DATE:	Thursday, 15 June 2017
TIME:	13:00 – 13:45 + questions
PLACE:	Auditorium 074, Building 421, DTU, Technical University of Denmark

Danish pastry, coffee and tea will be served 15 minutes before the seminar starts.

All interested persons are invited.

Niels Leergaard Pedersen

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