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Guest Lecture

Title: "Microstructural Design and Architecture of Hard Coatings for Severe Applications: An Experimental and *Ab Initio* Study"

Speaker: Prof. Dr. Paul H. Mayrhofer

Address: Institute of Materials Science and Technology, Vienna University of Technology, Vienna, Austria

Date: Friday, 15th of November 2013
Time: 14:30
Place: Seminar Room CBEG02 (387, Photonics); Gußhausstraße 27

Abstract:

This work summarizes recent developments on applying thin film structure and architecture concepts to hard coatings for optimized performance in various application fields. Hard coatings deposited by plasma-assisted vapour deposition are widely used to reduce friction and wear of tools and engineering components in energy, automotive and aerospace industry.

We will look in more detail into the correlation between microstructure and mechanical and thermal properties of hard ceramic coatings. This is done for single-phase coatings and composition or phase modulated layers. In the latter case, the microstructure can be designed by choice of the deposition technique, understanding the growth processes taking place on a film surface, either by sequential deposition of layers or by taking advantage of self-organization processes including segregation effects of the elements. Consequently, the effects of individual microstructural features like grain size, defect density (and hence residual stress), phase arrangements in an one-, two- or three-dimensional manner on the mechanical properties are treated.
By using *ab initio* calculations and sophisticated experimental methods we will have a detailed insight into various mechanisms responsible for excellent

mechanical strength, thermal stability and oxidation resistance properties of e.g., Ti–Al–N, Cr–Al–N, and Zr–Al–N hard coatings. For these materials we will also compare the effect of various architecture and alloying concepts with e.g., Y, Zr, Hf, Nb, and Ta.

As the brittleness of such ceramic-like coatings often negatively influences their performance, especially when used in conditions with an increased need for crack resistance, we will also discuss this topic by using *in-situ* electron microscopy micro- and nano-mechanical investigations of CrN/AlN multilayers.

The various thin film structure and architecture concepts allow the utilization of multifunctional properties facilitating the development of next generation's hard coatings.