

Delamination and Adhesion of coatings and thin films. Michel Ignat DR
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The use of thin films and coatings expands continuously. Nowadays it includes rather different technological applications as the ones related to tribological applications, microelectronics or biotechnologies.

However, to consider any of the mentioned applications, a certain number of problems have to be understood and solved. Indeed, film on substrate systems are subjected to internal stresses produced by thermo elastic mismatch, or to external mechanical stresses applied monotonically or cyclically. Then they are likely to be damaged by mechanisms that produce bulk and/or interfacial delaminating failures. Consequently, the knowledge of critical conditions to produce the above mentioned failure mechanisms, remains an essential aspect to investigate, to establish the mechanical reliability of coating(s) or thin film(s), on substrate systems, before any application.

A variety of different degradation mechanisms of mono and multilayer deposited on a substrate, can be observed and analysed when performing a test in a Scanning Electron Microscope.

From the experiments and observations, confronted to analytical models of fracture mechanics, the parameters which characterise the system behaviour can be determined. Besides this analysis of the damage evolution, points out the importance of the interfacial structural properties (roughness, impurities etc), on the systems behaviour.

The seminar will be focused on experimental aspects and calculations which allow to analyse the coating on substrate failure.

Examples of **References** in the past 5 years:

-see Chapter 2: "*Stresses and Mechanical Stability*" in Chemical Vapour Deposition, **ASM International Series** (edited in 2001);

in **Thin Solid Films**:

-"*Mechanical Properties of W and WC thin films; Young Modulus, fracture toughness and adhesion*" 332,(1998) 195-201;

-"*Analysis of the mechanical response of film on substrate systems presenting rough interfaces*"315,(1998) 207-213;

-"*The effects of particle pollution on the mechanical behaviour of multilayered systems*" 348,(1999) 215-221;

-"*Mechanical behaviour of submicron multilayers submitted to microtensile experiments*" 353,(1999) 201-207.

in **Journal of Applied Physics**:

-"*Analysis of local mechanical stresses in and near tungsten lines on silicon substrate*" 85,(1999) 1-9

in **Surface and Coatings Technology**:

-"*Cracking investigation of W and WC films deposited by physical vapour deposition on steel substrates*" 111,(1999) 177-183.

Appeared in 2002, in **Journal of Orthopaedic Research**:

-"*Fracture response of a cancellous bone-cement (PMMA) composite*", and

in **Journal of Adhesion Science and Technology**:

-"*The role of a metallic interlayer on the mechanical response of SiC coatings on stainless steel substrates*".