ELASTIC PROPERTIES OF NANO-STRUCTURED THIN FILMS: CHARACTERIZATION AND MODELING

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Understanding the mechanical behavior of nano-structured thin films in relation with their microstructure is of high importance for the development of technological applications. We are focusing our research on the investigation of the elastic properties of such materials. Model nanometric W/Cu [1] and W/Au multilayer systems exhibiting different microstructures are elaborated, the microstructure of which being characterized by TEM (grain shape, layer thickness …), X-ray reflectometry (multilayer period, density) and X-ray diffraction (XRD: crystallographic texture, layer thicknesses). These films are supported by a polyimide foil substrate. Films mechanical response is characterized experimentally by XRD based in-situ techniques [2] to assess the orientation and depth dependences of elastic strain and stress. Results are interpreted by an appropriated mechanical modeling accounting for the material microstructure, based on homogenization schemes. An in-situ biaxial tensile apparatus is currently developed in the frame work of the French Agency for Research (Cmonano project, ANR-05-PNANO-069) and will be installed at Diffabs beam line of the new French synchrotron SOLEIL. This machine allows exploring many different configurations of applied stress together with a high resolution characterization by diffraction.

[1] B. Girault, P. Villain, E. Le Bourhis, P. Goudeau, P.-O. Renault (2006) "X-ray diffraction analysis of the structure and residual stresses of W/Cu multilayers", Surface & Coatings Technology **201**, pp. 4372 – 4376.
[2] D. Faurie, P.-O. Penault, E. Le Bourhis, Ph. Goudeau, O. Castelnau, R. Brenner and G. Patriarche (2006) "Elastic behavior of polycrystalline thin films inferred from in situ micromechanical testing and modeling", Applied Physics Letters **89,** 061911.