Characterization of chemical processes and interfacial diffusion in Pd/Y multilayers using HAXPES induced by standing waves

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We characterize Pd/Y multilayer and several derivative systems [1] designed to work in λ=7.5-11 nm range, using hard x-ray photoemission spectroscopy (HAXPES) combined with x-ray standing waves [2]. Experiments will be performed in September at the GALAXIES beamline of the SOLEIL synchrotron facility in France. Investigation of the real physical structure of the samples (interface roughness and diffusion, compound formation) and the relation to the experimental performance will help optimize the deposition process and improve its optical properties. The Pd L3 and M5, Y L3 and M5, B K, and C K HAXPES spectra of five samples with and without the B4C barrier layer of different thicknesses will be measured. The incident photon energy will be 10 keV in order to prbe a few periods of the stacks. The chemical processes taking place in the Pd/Y multilayers without diffusion barrier, or with B_4C layers of different thickness acting as diffusion barriers will be identified. Structural information of the multilayers will be revealed by comparing the experimental data with simulations. We expect to obtain a clear in-depth description of the stack from its chemical structure point of view. The effect of oxidation of the very first of the stack will be observed and the different chemical states of the various elements located, either at the interfaces or in the center of the layers. The positioning of x-ray standing waves enhancement for the emission is realized by rotating the grazing incident angle around Bragg angle as shown in figure 1 where the x-ray standing waves' anti-nodal plans are placed on Y-on-Pd interfaces as a result of constructive interferences, thus such the photoelectron emission on such interfaces will be enhanced while the emission at Pd-on-Y interfaces is minimized because of the destructive interferences.

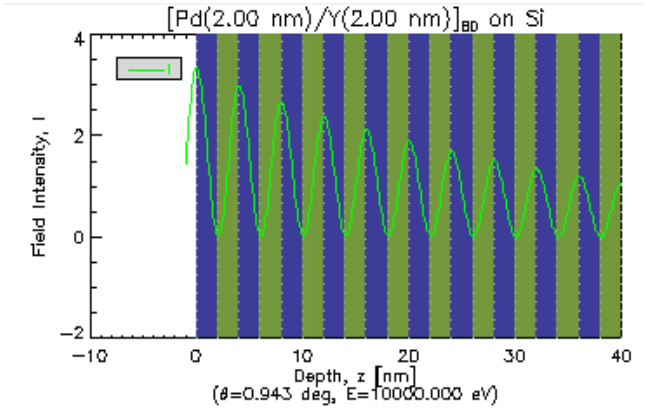

Figure 1: Simulation of field intensity in the Pd/Y multilayer stack. Grazing angle is set at the Bragg angle calculated with incident beam energy (10 keV) and multilayer period (4 nm).

References

[1] Dechao Xu et al. Enhancement of soft X-ray reflectivity and interface stability in nitridated Pd/Y multilayer mirrors.

[2] A. Giglia et al. Thermal effects on Co/Mo2C multilayer mirrors studied by soft x-ray standing wave enhanced photoemission spectroscopy, Proc. SPIE 8777, 87770I (2013).