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Study of Pd/Y multilayers with B$_4$C barrier layers using GIXR and x-ray standing wave enhanced HAXPES

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Pd/Y multilayers are high reflectance mirrors designed to work in the 7.5-11 nm wavelength range. Samples, prepared by magnetron sputtering, are deposited with or without B$_4$C barrier layers located at the interfaces of Pd and Y layers to reduce interdiffusion, which is expected by calculating mixing enthalpy of Pd and Y. Grazing incident x-ray reflectometry is used to characterize these multilayers. B$_4$C barrier layers are found effective on reducing the Pd-Y interdiffusion. Details of the composition of the multilayers are revealed by hard x-ray photoemission spectroscopy under x-ray standing waves effect. It consists in measuring the photoemission intensity from samples that perform an angular scan in the region corresponding to the multilayer period and the incident photon energy according to the Bragg law. The experimental result indicates that Pd does not chemically react with B nor C at the Pd-B$_4$C interfaces while Y does at the Y-B$_4$C interfaces. The formation of Y-B or Y-C chemical compound can be the reason why the interfaces are stabilized. By comparing the experimentally obtained angular variation of the characteristic photoemission with the theoretical calculation, the depth distribution of each component element can be interpreted.

Figure 1: (A) Experimental setup and (B) depth distribution of the x-ray standing wave electric field within a B$_4$C/Pd/B$_4$C/Y multilayer irradiated by a 10 keV photon beam.

References