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Depth selective local coordination in amorphous CoxFeyBz thin films probed by XAFS under x-ray standing wave condition

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Heterostructures consisting of HM/CoxFeyBz/HM (HM being heavy metals like Mo, Hf, Ta, W) may develop peculiar properties at the interfaces, such as interfacial Dzyaloshinskii–Moriya interaction (IDMI), Spin Hall effect (SHE), perpendicular magnetic anisotropy (PMA), which are valuable for low power spintronic developments [1]. IDMI is also responsible for chiral domain walls and skyrmions, which hold great potential for high density non-volatile memory devices. The local atomic coordination and perpendicular homogeneity in amorphous CoxFeyBz interlayer may significantly affect the interfacial interactions with the HM layers, and hence the functional properties of the system. In general, the atomic coordination of amorphous the CoxFeyBz layer significantly differs from bulk metallic glasses of similar composition because of the influence of HM interactions, deposition process, and eventual post deposition treatments. Elucidating the local structure and coordination at the atomic scale of the CoxFeyBz layer is relevant because atomic scale mechanisms intimately affect the functional properties of HM/CoxFeyBz/HM multilayers. The x-ray absorption fine structure (XAFS) spectroscopy, being a chemical selective probe for the local atomic structure, is especially suited to this aim, and, in the case of such multilayer structure, can be coupled with the x-ray standing wave (XSW) geometry to access depth selective information [2]. A recent experiment carried out at the XRF- Beamline (Elettra) [3] has demonstrated differences between Fe and Co local atomic structure and significant vertical inhomogeneities in the CoxFeyBz with evident differences between the coordination of Fe and Co located close to the HM interfaces and in the center of the layer.

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