Interface roughness of the refractory metal based X-ray multilayers prepared by various deposition techniques

S. Luby, E. Majkova. M. Jergel
Institute of Physics, Slovak Academy of Sciences, 842 28 Bratislava, Slovakia

F. Hamelmann, G. Haindl, U. Kleineberg, U. Heinzmann
Faculty of Physics, University of Bielefeld, 33615 Bielefeld, Germany

Interface roughness (σ) of multilayers (MLs), its lateral (ξ) and vertical (L_{vert}) correlation lengths considerably influence the reflectivity of X-ray multilayer mirrors. In this paper the roughness characteristics σ, ξ, L_{vert} of Mo, W and Ti based MLs prepared in our previous works by evaporation, sputtering and plasma enhanced MOCVD (sometimes combined with ion polishing) are compared and their influence on the reflectivity of MLs is discussed.

The hard X-ray reflectivity, soft X-ray reflectivity and diffuse scattering at the grazing incidence of X-rays completed by the atomic force microscopy were employed for the measurements. This way the real geometrical roughness of MLs separated from the influence of the compositionally graded interfaces was obtained.

From results if follows that the roughness decreases and the correlation lengths increases when the deposition is isotropic and the behavior is opposite when the deposition is more anisotropic or even oblique. All roughness characteristics may decrease under certain conditions of Ar^+ ion etching. The deposition energy of adatoms, structure of the layers (amorphous, crystalline) and the compound formation in MLs is discussed as well. Moreover, it is shown that the reflectivity of MLs may be considerably different even for similar rms roughness but different roughness correlation lengths.

Corresponding author: S. Luby email: luby@savba.sk