

Roughness of Ultra-Short-Period W/B₄C Multilayers by Specular and Diffuse X-Ray Scattering - Microstructural Limits on Reflectivity

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W/B₄C multilayers have been fabricated by magnetron sputtering with periods from 50Å to as small as 4.7Å. Fits of the specular reflectivity for rms roughness give different trends for the evolution of vs. d, with the roughness increasing from ~2Å to ~7Å (approximately consistent with compiled results of other workers) when fitting the first peaks, and remaining constant near 2Å when fitting the entire available range of R(). This is explained in terms of an inferred power-law PSD of the roughness consistent with the substrate roughness, and the change of spatial frequency sensitivity with incident angle. The multilayers were found to have a discontinuous morphology below about d = 15Å, which contributes to the PSD at high frequencies. Corroborating evidence from cross-section HRTEM and various diffuse-scattering measurements will be presented.