Six Ways of Determining Film Thickness from High Resolution XRD Data

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The thickness of coherently scattering domains can be obtained from high-resolution X-ray diffraction (HRXRD) data using the Scherrer equation, rocking-curve modeling, thickness fringe analysis, Fourier analysis, and the Warren-Averbach method. In addition the same value can be obtained from X-ray reflectivity measurements. We thought it would be interesting to compare the thickness values obtained from a set of ideal samples (semiconductor grade silicon-on-insulator thin films) using all of these techniques and check the results with data obtained from cross-sectional transmission electron microscopy. Our results show that the absolute accuracy of thin film thickness values obtained from HRXRD data is approximately 1 nm for all techniques if all sources of broadening are correctly identified, while their precision is one or two orders of magnitude smaller.