B17

Multilayer roughness and image formation in the Schwarzschild Objective

Sangeet Singh, Harun Solak, and Franco Cerrina
Center for X-ray Lithography (CXRL), University of Wisconsin, 3731 Schneider Drive, Stoughton, WI 53589

We present a study of the effect of multilayer surface roughness-induced scattering in the image formation of the Schwarzschild Objective used in the spectromicroscope MAXIMUM. The two mirrors comprising the S.O. are coated with RuB(4)C multilayers that have a peak reflectivity at 130 eV. We have long observed that a diffuse x-ray background surrounds the focused x-ray spot. The spatial resolution remains at 0.1 micron, nevertheless. However, since a significant fraction of the flux is lost to the background, since too large an area of the sample is illuminated, and since the S/N ratio is degraded, the origins of this effect merit investigation. This diffuse background resulting from x-ray scattering at the surface of the mirrors was mapped out using bi-directional knife edge scans. Complementary surface roughness simulations were carried out with the ray-tracing program SHADOW. AFM experiments were also done to directly measure the surface roughness and power spectrum of representative multilayers. Following curve fitting, it was possible to classify Gaussian components in both the measured and simulated profiles as arising from scattering occurring at either the convex primary mirror or the concave secondary mirror. Together with geometrical analysis, these techniques permitted us to track the image formation process of an actual optical system in the presence of surface roughness.