Cr/C multilayer mirror for Ni-like Ta X-ray laser application

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Abstract: Soft X-ray laser working in or near the "water window" (22.8 - 43.6 Å) region enables many fundamental and applied researches. The working wavelength of Ni-like Ta soft X-ray laser is 44.83 Å, just near the "water window". High reflection multilayers are required for this application in China. In this work, we design and fabricate carbon-based multilayer reflective mirrors. Cr/C multilayer was selected from proposed candidates such as Co/C, Ni/C, and CoCr/C material combinations. The period thickness of bi-layer is only 22.6 Å. Therefore, the interface roughness and diffusion will strongly reduce the multilayer reflectivity. Moreover, the bi-layer number is much larger than several hundreds. Cr/C multilayer was deposited by magnetron sputtering technique. Multilayers with bi-layer numbers of 150, 200, 250 and 300 were deposited onto super polished silicon substrate with surface roughness 3 Å. All multilayers have been characterized by grazing incident X-ray reflectance (XRR). Then, the near-normal incidence reflectance measurements were performed at beamline 3W1B, Beijing synchrotron radiation (BSRF). Transmission electron microscopy measurement also clearly shows the sharp Cr-C interface in multilayer. All measured results show well defined multilayer structure and marvelous optical performance. Figure 1 shows that the highest reflectance of 13.2% for the 300-bilayer Cr/C multilayer mirror at near normal incidence.

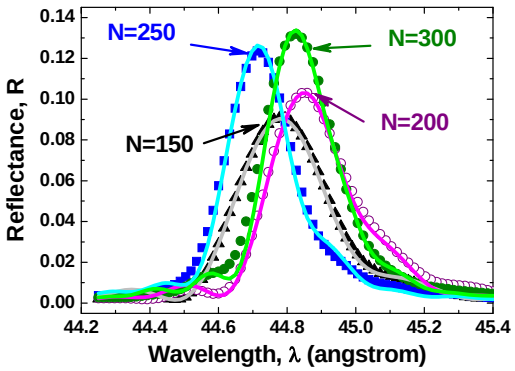

Fig. 1 Near-normal reflectance of Cr/C multilayers measured at 3W1B, Beijing synchrotron radiation facility

(dots for measured data, solid line for fitted ones)

Keywords: multilayer; X-ray laser; reflectance mirror; synchrotron radiation

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