Influence of substrate biasing on NiC/Ti multilayer performance

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The application of NiC/Ti multilayers for use in neutron guides as a high performance mirrors is plagued by poor morpholodgy [1]. Currently, neutron reflectivity of more than 90% has been achieved beyond 2.8 times the critical angle of a Ni mirror [2]. To increase the angle of reflection from 2.8 to 3.0 times the critical angle with a reflectivity of more than 90%, a depth graded NiC/Ti structure of thickness 3.4 microns must be fabricated. Unfortunately, films with this thickness have the inherent problems associated with poor adhesion and increasing interfacial roughness.

The influence of substrate voltage biasing on W/B4C and Mo/Si X-ray multilayer mirror performance has been described in [3,4]. In the present work, the biasing influence on the characteristics of NiC and Ti single films and multilayers as prepared by magnetron sputtering techniques is considered. Analytical methods include low and high angle XRD, RHEED and AES for investigation of layered materials density, crystalline structure, composition and interfacial roughness. An optimal range of substrate bias voltage producing the best quality layer deposition was found. Taking into account the results of these investigations, a depth graded NiC/Ti multilayer structure with total thickness of 3.4 microns was prepared on a glass substrate with dimensions 250mm x 80mm. Results of reflectivity at wavelengths ~ 4 angstroms are presented.

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