Selected area diffraction using nano-electron-beam for NiC/Ti multilayers

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Artificial multilayer mirrors play an important role in optical components to control the momentum, speed and spin of a neutron. Improvement of the performance of multilayer mirrors with small d-spacing, which are utilized for monochromators, supermirrors, and polarizers, has been energetically conducted. The microstructure of thin films and its interfaces is interesting subject.

In this study, the microstructure of NiC/Ti multilayer mirrors with small d-spacings has been characterized using nano-electron-beam. NiC/Ti multilayers have been deposited using ion beam sputtering as a function of carbon mixing ratio. Selected area diffraction (SAD) patterns are obtained for the NiC layers, NiC/Ti interfaces, Ti/NiC interfaces and Ti layers of NiC/Ti multilayers with various carbon mixing ratios. The observations have been conducted using a transmission electron microscope (HITACHI, HF-2000) with the incident beam with a diameter of 10Å.

Obvious structure differences are observed in the SAD patterns. A spot pattern for the NiC layer with a carbon mixing ratio of 12% shows the single crystalline structure in the observed area. For the other NiC thin layers with carbon mixing ratios shows hallow patterns, then the thin films form the amorphous structure in the observed area. All Ti thin layers show the quasi-amorphous structure. It is clearly observed that sharp interfaces are created with quasi-amorphous compound.