Grazing-incidence diffuse scattering for Ni/C multilayers

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Introduction

The Ni/C multilayer is one of the most useful optical mirrors for soft X-rays [1,2]. It is significant in the investigation of interfaces because the preparation of a perfect layer-stacking structure is crucial to obtaining high reflectivity. In this study, diffuse scattering around the Bragg condition was measured.

Experimental

The sample measured is $[Ni(16.6Å)/C(18.8Å)]_{100}$ (2d=70.8Å) deposited on a silicon substrate, prepared by sputtering. The experiment was carried out with 16keV monochromatic X-rays. Details of the grazing incidence X-ray reflectometer can be found elsewhere [2].

Results and Discussion

Fig. 1 shows a typical 2D rocking scan around the 1st Bragg peak (11.26 mrad), which was performed by scanning glancing angle θ_i for a fixed scattering angle series ($\theta_i+\theta_f$). While a strong Bragg reflection peak with many fringes is visible as a specular reflectivity curve, one can see that diffuse scattering also becomes strong at the same scattering angle at around 22.5 mrad (qz =1.83 nm^{-1}). This is due to the strong correlation with the interface roughness, and such enhancement has sometimes been reported for a Ni/C multilayer [2]. Preliminary analysis indicates that both the rocking curves (qx scan) and longitudinal curves (qz component of 2D scan) obtained at the off-Bragg condition appear rather close to Lorenzian. Fig 2 shows the full width at the half maxima (FWHM) of the rocking curves as a function of qz. It is approximately proportional to qz^2, except for some oscillation around the Bragg condition. Those results indicate a certain typical Fractal morphology, corresponding to a Hurst parameter of around 0.5 [4]. The authors would like to thank Prof. S. Kishimoto for his kind assistance during the experiment.

References

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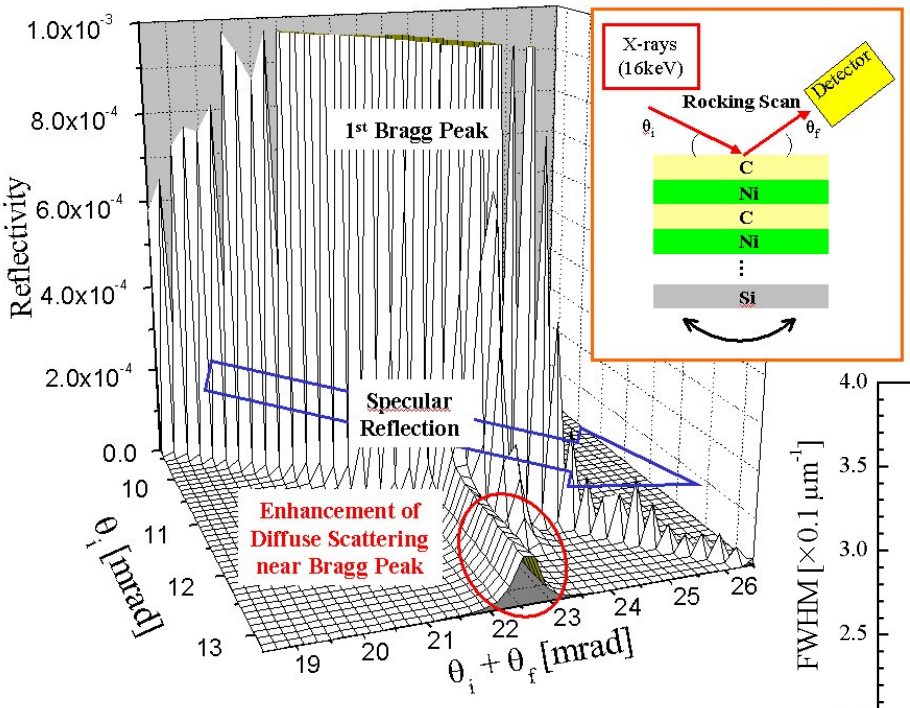

Figure 1 (up) 2D rocking scan for a Ni/C multilayer. Glancing angle θ_i, 9.26~13.26 mrad with 0.1 mrad step. Scattering angle $\theta_i+\theta_f$, 18.52~26.52 mrad with 0.2 mrad step. Measuring time 5 sec/point.

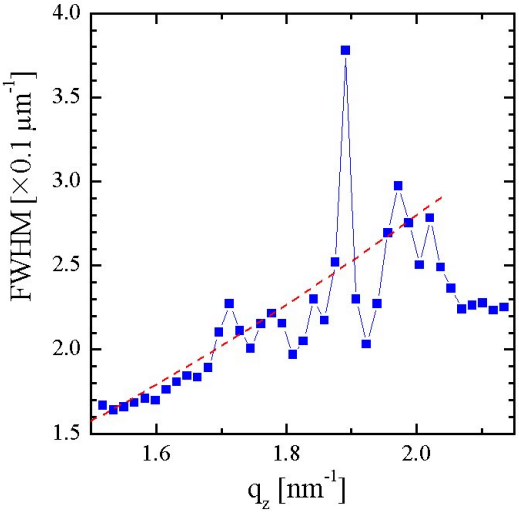

Figure 2 (right) FWHM of rocking curve observed in Fig.1. Parabolic dependence on qz is shown by dashed line for reference.