

GRAZING INCIDENCE X-RAY DIFFUSE SCATTERING FROM QUARTZ MIRRORS

Hiromi EBA and Kenji SAKURAI

National Research Institute for Metals, Sengen, Tsukuba, Ibaraki 305-0047

Introduction

Grazing incidence X-ray reflectometry is a surface-sensitive analytical method.¹⁾ Specular reflectivity of a sample surface permits the analysis of density profile and roughness as a function of depth, while diffuse scattering gives detailed information on lateral surface, i.e. correlation distance and/or Fractal parameter. In this study the technique has been applied to the evaluation of synthetic quartz mirrors with different surface finish.

Experimental

Specular reflection and diffuse scattering was measured with 16 keV monochromatic X-rays at BL-14A. Other experimental details are described elsewhere.²⁾

Results and Discussion

Measured samples are synthetic quartz mirror (25mmx25mmx5mm) with optically flat surfaces of different quality, OPSQ20-2 (flatness $\lambda/20$, $\lambda=632.8\text{nm}$), OPSQ10-5 ($\lambda/10$), OPSQ4-5 ($\lambda/4$) and OPSQ1-3 (λ), which are commercially available from SIGMA KOKI Co., Ltd.

Figure 1 shows X-ray specular reflectivity of each sample. The smoothest sample OPSQ20-2 has the highest specular reflectivity even at rather high angle region (6~14 mrad). The order of the reflectivity agrees well with the surface finish. Figure 2 shows X-ray diffuse scattering intensity measured by rotating the sample at a fixed detector angle of 1 deg. (rocking scan). Sharp peaks (Yoneda Wing) observed at 1.9 and 15.6 mrad are caused by enhancement of X-ray electric field intensity at the critical angle of synthetic quartz (SiO_2). It was found that intensity is strongly correlated to the surface roughness. Surface morphology of each sample was also observed by AFM, which can give significant information as a comprehensive image. The results are in good agreement with X-ray data shown in Figs. 1 and 2. Further

detailed analysis is in progress.

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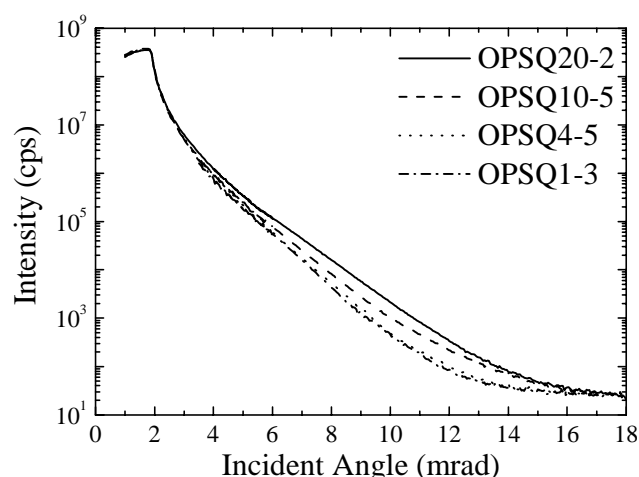


Fig. 1 X-ray specular reflectivity of synthetic quartz mirrors. Measuring time 80 min.

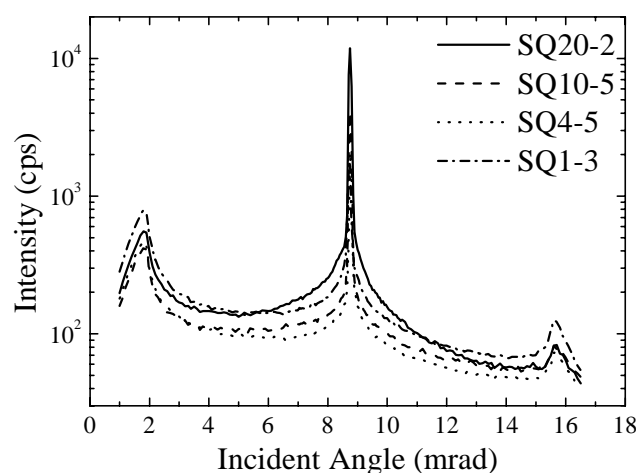


Fig. 2 X-ray diffuse scattering profiles of synthetic quartz mirrors. Measuring time 140 min.

References

- 1) K. N. Stoev and K. Sakurai, *Spectrochim. Acta* **B54**, 41-82, 1999.
- 2) H. Eba and K. Sakurai, PF Activity Report, this issue.