Characterization of polished silicon surfaces by the grazing incidence X-ray diffraction topography

*Takeo KATOH(4262)[a], Ken NAKAJIMA(4580)[a], Tsuyoshi HARADA(4579)[a], Atsushi SHIMAZU(4607)[a], Hiroyuki SHIRAKI(4581)[a], Hideyuki KONDO(4606)[a], Yasushi SHIMANUKI[a], Junji MATSUI(1232)[b], Yasushi KAGOSHIMA(1230)[b], and Yoshiyuki TSUSAKA(1231)[b]

a) Silicon Research Center, Mitsubishi Materials Corporation, Saitama 330-0835, JAPAN
b) Department of Material Science, Faculty of Science, Himeji Institute of Technology, Hyogo 678-1297, JAPAN

We have verified and developed[1] the grazing incidence diffraction topography[2] in order to characterize the quality of silicon wafer surfaces. Not only surface-selectivity but the application to large area is needed for the technique, as the size of wafers become larger. Here we report the progress of our work.

Silicon wafers (CZ, (100), p-type 10Ωcm) prepared by stock removal polishing were chosen for the samples. We set up the experimental arrangement for the grazing incidence diffraction topography on BL24XU. The energy of the monochrome beam was selected so as to satisfy a Bragg condition of a (444) asymmetric reflection at grazing incidence on (100) surfaces and to be around the first order peak of the undulator spectrum.

Fig. 1 shows the beam energy dependence of incident angle and peak intensity of the diffraction. As the beam energy increases in this range, the incident angle approaches the critical angle. And the intensity of the diffraction becomes extremely weak as the penetration depth of x-ray becomes shallow. Even on this condition (E=9.684keV), the brilliant undulator radiation of BL24XU enabled the surface-sensitive topography with synchronized traversing of the specimen and the film. **Fig.2** is a topograph of a silicon wafer prepared by stock removal polishing obtained at E=9.684keV.

Taking account of the refraction effect[3] in this case quantitatively, we concluded that not only near-surface lattice strain but slight roughness of the surface made the diffraction contrasts. However, we have established the surface-sensitive topography covering large area, which is effective to characterize and develop modern silicon wafers.

References

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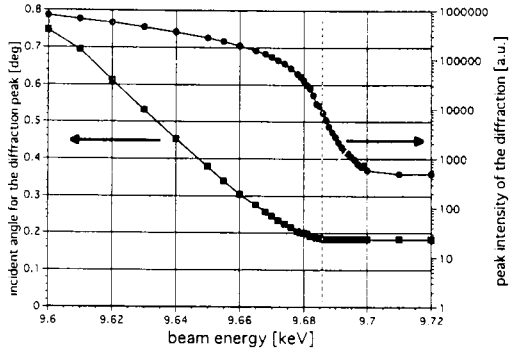

Fig.1 Variations of the incident angle and the peak intensity of the diffraction with the beam energy.

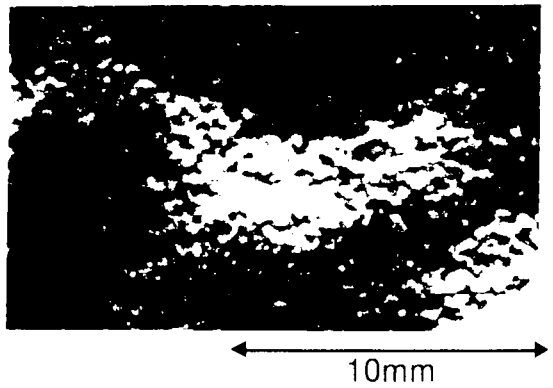

Fig.2 A x-ray topograph of a silicon wafer prepared by stock removal polishing obtained at E=9.684keV.

*Email: tkatoh@mmc.co.jp