3-D Observation Technique of Dislocations in Silicon Crystal with X-ray Topography

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The lattice defects in silicon crystals have three-dimensional distribution. The evaluation technique should provide three-dimensional information of these defects. X-ray topography is the only way to nondestructively characterize the defects in the single crystal with high sensitivity to strain. However, a laboratory X-ray source is too weak to provide three-dimensional information by X-ray topography. Synchrotron light source showed the possibility of three-dimensional X-ray topography [1]. In this report, we describe the techniques of three-dimensional X-ray topography and its applications at SPring-8.

Three-dimensional X-ray topography is performed at BL28B2 white X-ray diffraction beam-line. The sample mounted on the diffractometer is irradiated by white X-rays from the bending magnet light source. The diffraction topographs from the sample are recorded with the high-resolution X-ray camera. Three-dimensional images are taken by the step-scanning section topography [2, 3] or the topo-tomography technique [4]. In either technique, several hundred topographs are required in order to reconstruct three-dimensional image. The experimental system of BL28B2 can acquire these topographs automatically.

Figure 1 is a conventional two-dimensional projection topograph of dislocations in the neck part of Cz-silicon single crystal. The dislocation images indicated by the arrows in Fig. 1 are straight line form. These dislocations showed half-loop form in three-dimensional topograph as shown in Fig. 2. The straight line images were side-view image of the half-loop dislocations on the glide planes. Three-dimensional topography is essential technique in order to determine the actual shape of dislocations.

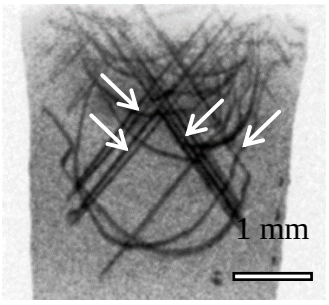

Fig. 1. 2D X-ray topograph of dislocations in CZ-Si single crystal.

Fig. 2. 3D X-ray topograph.

References

[1] K. Kajiwara, S. Iida, T. Mukaide and S. Kawado: 14th International Conference on Defects Recognition, Imaging and Physics in Semiconductors, Miyazaki (2011).

[2] A. L. Andersen and L. Gerward: *Phys. Status Solidi a* **23**, 537 (1974).

[3] T. Mukaide, K. Kajiwara, T. Noma and K. Takada: *J. Synchrotron Radiat.* **13**, 484 (2006).

[4] W. Ludwig, P. Cloetens, J. Härtwig, J. Baruchel, B. Hamelin and P. Bastie: *J. Appl. Cryst*. **34**, 602 (2001).