Crystallography

15C/2010G026

Observation of Topography using Resonant Scattering and SEM Images

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Introduction

Near the K-absorption edge of a constituent atom in a crystal, X-ray rocking curves from the crystal sometimes show significant change due to resonant scattering even when the change of X-ray energy is small. It will be interesting to study the change of topographies by using this significant change due to resonant scattering.

Experiments

Fig.1 shows the measured GaAs 200 diffracted rocking curves I_h, and transmitted ones I_t in the Laue case [1] when X-ray energy is just below Ga K-edge (a), and 453.7eV below As K-edge (b). In (a), the rocking curves of I_h and I_t are anti-phase to each other [2], while in (b), the maximum intensities due to anomalous transmission for I_h and I_t appear at the same angle and fringes in their tails are in-phase to each other. Figs. 2(a) and (b) show the topographies recorded at the X-ray energies in Figs. 1(a) and (b), respectively. The interference fringes are clearly observed in the upper side of defect α (see arrow in (a)). The area around the defect α shows a dark band in (b).

Fig.3 shows a scanning electron microscopy (SEM) image of the same region as in Fig. 2 observed from the incident surface of X-ray. Along the defect band observed in the topographies in Fig. 2, many ditches are observed running in the [110] direction.

Conclusion

It is noted that the topography making use of resonant scattering is very useful not only for obtaining information on the strain around a defect from the interference fringes in Fig. 2(a) but also for obtaining the structural information of the defect from the image contrast caused by Borrmann effect as shown in Fig. 2(b).

This work was partly supported by the 'Open Research Center' Project for Private Universities: 2007-2010 matching found subsidy from the Ministry of Education, Culture, Sports, Science and Technology.

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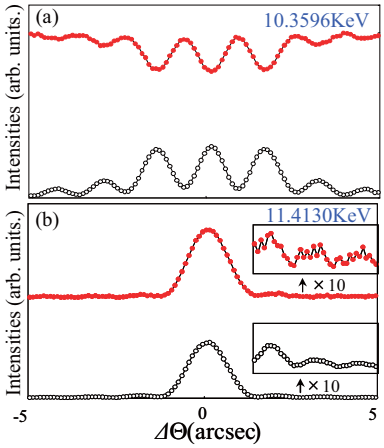

Fig.1 Measured GaAs 200 rocking curves in Laue case at two X-ray energies. Crystal thickness is 45μm.

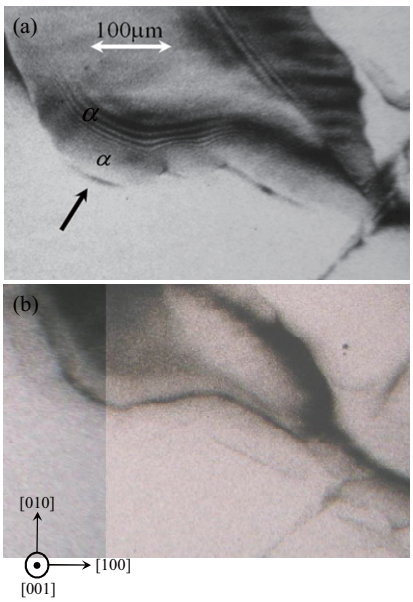

Fig.2 Topographies (a) and (b) recorded at two energies in Figs.1(a) and (b), respectively. Topography in (b) is composed of two topographies.

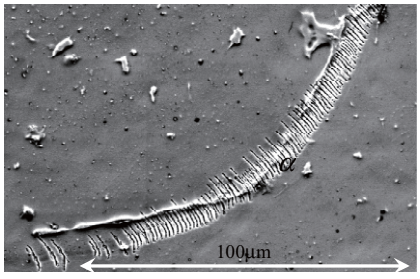

Fig.3 SEM image of the same region as in Fig. 2. Ditches are observed along α.