Measurement of lattice strain around microdefects in silicon crystals by plane wave X-ray topography

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In order to characterize grown-in defects in CZ-Si crystal, plane wave X-ray topography experiments were carried out at the second experimental station of the BL20B2. The experimental arrangement was similar to those of previous plane wave topography experiments [1, 2]. A sample crystal was an as-grown, both side mirror polished, 0.5 mm thick, CZ-Si wafer grown at a pulling rate of 0.4 mm/min. Rocking curves of the sample were measured in a symmetric Laue geometry using 30 keV plane wave X-rays. Plane wave X-ray topographs of 000 and 220 reflections were recorded at several angles of the rocking curve.

Figure 1 shows a measured rocking curve of 220 reflection, where an oscillatory profile is clearly observed. Figure 2 shows an example of topographic images of a defect. Change of the defect image according to the X-ray incident angle is clearly observed.

Fig. 1. Measured rocking curve of 220 reflection of a CZ-Si crystal.

Fig. 2. Plane wave X-ray topographs of 000 and 220 reflections of a grown-in microdefect of a CZ-Si crystal wafer measured at five incident angles as shown in Fig. 1.

Distribution and contribution rates of pulmonary and bronchial blood supply measured by multiple-contrast CT imaging.

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The purpose of this study is to visualize pulmonary two vessel systems (pulmonary and bronchial circulations) separately in three dimensions, and to compare the distribution and contribution rate of these two vessel systems in normal and hypertensive condition.

Materials and Methods Rats were placed in a vinyl isolator continuously ventilated with air and hypoxic gas (13% oxygen in nitrogen) for two weeks. In the anesthetized rats, pulmonary and bronchial arteries were filled up by labeled and H2O-labeled microspheres with a diameter of 15 μm, as the contrast materials for x-ray imaging respectively. The respiratory tract was filled up with 2% of agarose. The lung was dissected out and fixed with formalin-saline, and the tissue samples 3 mm in diameter and 10-20 mm in length was excised. The samples were exposed to monochromatic synchrotron radiation with just upper and lower energy levels of keV in each element. To construct the CT images, the samples were taken every 0.5-degree angle, turning it for 180°.

By subtraction processing on a computer, each image of the pulmonary and bronchial arteries were taken separately. For visualization of each vessel three dimensionally, these images were reconstructed on computer.

Results and Discussion Because of decrease in allocation of the shift time, we could not examine difference between distribution of pulmonary and bronchial circulations in normal and hypertensive condition. The reconstruction to three dimensional images was chief aim of this experiment. Figure 1A shows the image of pulmonary and bronchial arteries (37.44 keV). After the subtraction processing, pulmonary (B) and bronchial (C) arteries were visualized separately. Figure 2 shows the three-dimensional image of pulmonary and bronchial arteries in the lung. These results suggested that multiple contrast angiography is useful.

References
2) S. Iida et al., SPring-8 User Experimental Report, No. 7 (2001A).

Fig. 1. The images of pulmonary and bronchial arteries. A: pulmonary and bronchial arteries (37.44 keV), B: pulmonary artery, C: bronchial artery.

Fig. 2 Three dimensional image of pulmonary and bronchial arteries in the rat lung.