

Observation of Crack Initiation in Structural Materials by Refraction Contrast X-ray Imaging

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Refraction contrast X-ray imaging performed by synchrotron source with ultra-bright light and highly directional beam is thought to become a unique method to diagnose nondestructively cracks or voids formed in materials. This is because it is thought to provide us in principle completely different information from conventional methods such as absorption contrast X-ray imaging.

The imaging experiments were conducted to pre-tensiled steel plate(0.5mm in thickness) with MnS inclusions, using X-ray beam obtained from undulator in the experimental Hutch C of BL24XU (Hyogo BL) of SPring-8. The X-ray beam was monochromatized by Si double-crystals and collimated by slit. The X-ray energy was set to 25KeV. Photographs of the images were taken by X-ray film. Refraction contrast images were obtained by setting 3m in distance between the

sample and the X-ray film.

Fig.1 shows the refraction contrast X-ray image of the steel sample after tensile test. It is obvious that inclusions, which was confirmed to be MnS nonmetallic compounds by EPMA, are seen in steel. The dark contrast of the edge parts of inclusion is thought to confirm refraction image, and to indicate the formation of micro-cracks between the inclusion and matrix. The fact that the such images of nonmetallic inclusion were not obtained in non-tensiled sample is also thought to support above-mentioned conclusion.

From above, refraction contrast X-ray imaging method using SPring-8 seems to be very useful for fracture research of materials. This study was performed through Special Coordination Funds for promoting Science and Technology of the Science and Technology Agency of the Japanese Government.

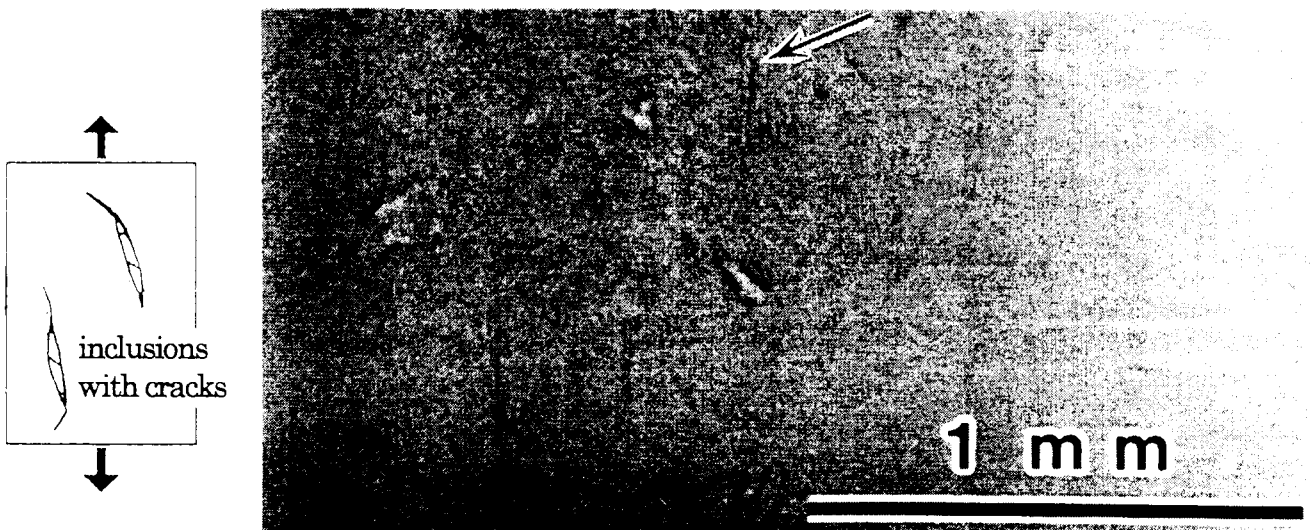


Fig.1 Refraction X-ray image of nonmetallic inclusions of tensiled steel with 0.5 mm in thickness taken at SPring-8. It indicates the formation of micro-cracks between inclusions and matrix.