

# Observations of Fatigue Cracks 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 A7075 Al alloy plate(1.0mm in thickness) and mild steel plate(0.5mm in thickness) with fatigue cracks using X-ray beam obtained from undulator in the experimental Hutch C of BL24XL (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 15KeV for Al alloy, and 25KeV for steel. 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. The absorption

images were also obtained by setting 0.05m in distance between them.

Fig.1 (a) and (b) show the absorption contrast X-ray image and the refraction contrast X-ray image of fatigue crack in Al alloy, respectively. It is obvious that the crack contrast of both images is reversal. That is, the former is bright, and the latter dark, confirming that the former is absorption image, and the latter refraction image. They also show that the refraction image is much more distinct than the absorption image. Very clear dark images of fatigue crack in mild steel were also observed by the refraction method.

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.

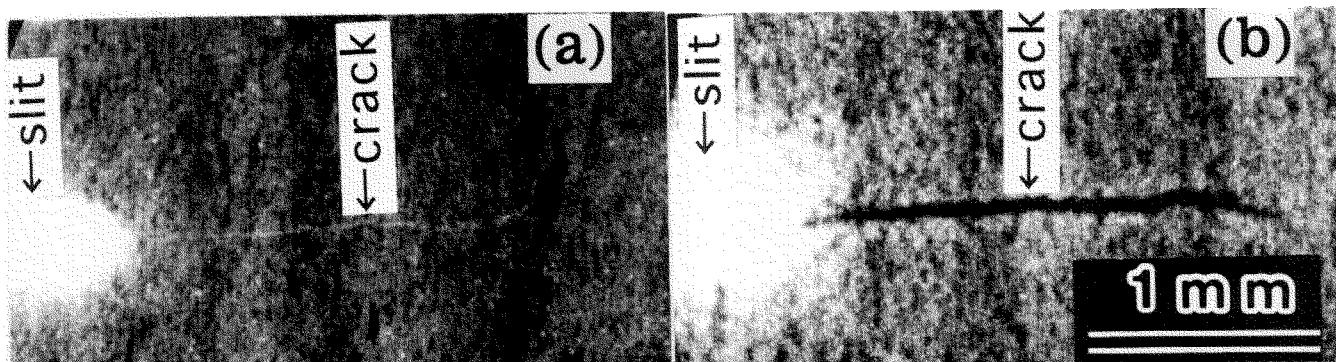


Fig.1 Images of fatigue crack in A7075 Al alloy plate with 1.0 mm in thickness taken at SPring-8.  
(a) absorption contrast X-ray image, (b) refraction contrast X-ray image