# SIMULTANEOUS MEASUREMENT OF IMAGING AND STRAIN OF FATIGUE CRACK IN STEEL BARS USING HIGH ENERGY SYNCHROTRON RADIATION

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Fracture mechanics have been successfully applied for damage tolerant design of engineering structures against fatigue and stress corrosion cracking. The stress intensity factor is a key parameter to predict the progress of cracking behavior, and is computed from the shape of cracks and the loading stress distribution. When cracks are propagating within bulk samples, nondestructive methods are required to determine the three-dimensional shape of cracks. In the present study, using monochromatic high energy X-rays from the synchrotron radiation source, SPring-8. we have developed a system to perform the simultaneous measurement of imaging of cracks and strain scanning around cracks within bulk samples. We applied the system to a part-through fatigue crack in a round bar made of carbon steel.

The measurement was carried at a beam line BL22XU at SPring-8 using monochromatic X-rays of 68.2 keV. The specimen was a round bar made of carbon steel (JIS-S45C) . The diameter of the specimen was 4 mm. A fatigue crack was generated from a drill hole with 0.1 mm in diameter and 0.05 mm in depth under completely reversed cyclic tension compression with the amplitude 240 MPa. Two specimens were prepared. The total length of a crack on the surface was 1 and 3 mm.

Computer tomography (CT) of the specimen was performed under the application of the maximum stress. The three-dimensional shape of a thumb-nail was successfully obtained using CT. Scanning of strain along the loading axis around cracks was conducted under the zero and maximum applied stresses. High tensile strain ahead of the crack was measured at the maximum stress, while the strain on the crack face was low because of crack opening.