

Visualization of 3D microstructure in porous metal materials at K-edge X-ray absorption by local tomography

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X-ray CT method is a kind of nondestructive inspection system, but must mold a sample small from a field of view (FOV) of detectors to do the quantitative measurement. Therefore, it is not the complete non-destructive measurement to scan a sample of the size that is beyond the FOV. Local tomography technique is the high-resolution reconstruction of a region of interests within a sample without molding.

Element sensitive tomography based on K-edge scanning has a great possible to be application to metal materials. By performing tomographies with energies above and below the K-edges of the elements, the concentration distribution of the elements are determined, respectively. As an example for application, the transformation of the concentration distribution before and after heat treatment can be 3D-visualized within metal materials with the progress of time.

The X-ray tomography experiments at K-edge X-ray absorption by local tomography were carried out at the BL47XU and BL20XU beamlines. The energy of the X-ray beam was 20keV and the combination of the CCD detector and the optical lens provided an isotropic voxel with a 0.474 μm edge. Tomographic scans above and below the Zn element absorption edge have been done. The aluminum foam samples (Al-Zn-Mg alloy foams) are a cylinder with the height and the diameter 7mm, and the cell wall samples in the aluminum foam with a length of about 2mm and a square cross section of 0.6x0.6 μm^2 were prepared with the solution treatment with 723K and 36000sec.

It is found that the Zn concentration distribution before and after heat treatment were transformed in the cell wall and the volumes of Al+Zn+Ti intermetallic compounds were increased. We also discuss about the 3D visibility at K-edge X-ray absorption by local tomography.