Fast Tomography during Continuous Tensile Tests

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Figure 1 (a) Standard tomography reconstruction of a commercial Al alloy. Voxel size 1.6 microns. ID15A.

One of the best methods for imaging the damage process in a material is to perform an in situ tensile test in a synchrotron X-ray tomograph. Tomography shows a non destructive image in the bulk and without bias due to surface preparation and/or surface stress state(1)(2). The ductile rupture process has then been imaged by several authors using tomography but with rather long exposure times, typically 1 second per radiograph and 1000 radiographs for one acquisition. This imposes the mobile grip of the tensile machine to be stopped during acquisition. Recently, Pyzalla et al.(3) have shown that fast tomography could be used to study the damage process during the creep of a metallic material.

Figure 1(a) shows the reconstruction of a commercial Al alloy the 5xxx serie after an acquisition in the standard tomography mode on the ESRF ID15A beamline (700 radiographs, long exposure time). The voxel size in this reconstruction is 1.6 μm. After an acquisition in the standard tomography mode on the ESRF ID15A beamline (700 radiographs, long exposure time). Figure b shows the same in the fast tomography mode (300 radiographs, short exposure time). The image in the faster mode is more noisy but the details of the microstructure can still be satisfactorily detected.

Figure 2 shows the evolution of damage observed using a voxel size of 2.8 μm during a continuous tensile test on a model material. Damage occurs by particle fracture similar to the one used in reference (1).

REFERENCES

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Method: Microtomography, characteristics: Continuous observation of fracture by fast tomography technique, conditions: A polychromatic X-ray of 60 keV and a monochromatic X-ray of 20.5 keV was used at ID15 and ID19, respectively in ESRF.