

FATIGUE CRACKS IN ALUMINUM SAMPLES STUDIED WITH X-PHASE CONTRAST IMAGING AND WITH ABSORPTION

S.R. Stock^{1,*}, K. Ignatiev¹, G.R. Davies², J.C. Elliott², K. Fezzaa³ and W.-K. Lee³

¹School of Materials Sci. & Eng., Georgia Inst. of Technology, Atlanta, GA, USA

²Dept. of Dental Biophysics, Queen Mary and Westfield College, London, UK

³Advanced Photon Source, Users Div., Argonne National Lab., IL

*On leave at Inst. for Bioengineering & Nanoscience in Advanced Medicine,
Northwestern Univ., Chicago, IL, USA

X-ray absorption microtomography, a high resolution variant of medical “CT”, quantifies three-dimensional microstructures efficiently and noninvasively. With this imaging modality, determination of the three-dimensional spatial distribution of crack opening as a function of applied load has helped clarify important physical processes of roughness-induced fatigue crack closure. There is a real need for sensitivity to crack openings smaller than those detectable by absorption tomography, particularly for sample geometries which are dictated by fracture mechanics and are far from optimum for microtomography. Phase contrast imaging with synchrotron x-radiation can provide very high sensitivity to small openings, and this paper compares results of phase contrast imaging and absorption microtomography for samples of AA 2090 T8E41 containing non-planar and branched fatigue cracks.