ACQUISITION AND ANALYSIS OF 3D MESOSCALE MICROSTRUCTURAL INFORMATION FOR PROPERTY MODELING

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Abstract

The development of high fidelity material property and life prediction models often requires three-dimensional information on the distribution of phases, grains or extrinsic defects across a broad range of materials systems. Acquisition of this information in appropriate representative volume elements ultimately limits the use of many conventional tomography techniques. Rapid generation of 3D mesoscale datasets with multiple channels of high-resolution information using a Tri Beam tomography platform will be discussed. The high pulse frequency (1 kHz) of ultra-short (150 fs) laser pulses can induce layer-by-layer material ablation with virtually no thermal damage to the surrounding area. The TriBeam platform has been employed to gather mm^3-scale datasets for metallic, polymer, ceramic and composite materials. Challenges in the acquisition, reconstruction and analysis of these 3D datasets will be addressed. The specific problem of fatigue crack initiation in a polycrystalline nickel-base alloy and the need for 3D data will be discussed. Digital image correlation combined with tomography has revealed the nature of the microstructural "neighborhoods" that result in fatigue crack initiation.