Microscale Digital Image Correlation of Carbon Fiber Composites in a Scanning Electron Microscope

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Digital image correlation is performed on scanning electron microscope (SEM) images of a composite microstructure subjected to varying uniaxial tensile load. The microstructure is patterned by multiple depositions of a low weight fraction (0.05%) gold nanoparticle suspension onto the surface. Correlated image pairs are used to quantify error and noise associated with the SEM imaging process. Imaging parameters include dwell time, acceleration voltage, and image integration. Increasing the acceleration voltage improved the signal to noise in the resulting image correlation, but results in e-beam related damage to the interfaces within the composite sample. Both an extended dwell time or image integration also result in an improved signal to noise. When total imaging length is kept constant, longer dwell time is favored over image integration for noise reduction, however image integration has the added benefit of removing error associated with the SEM rastering process. An overview of the experimental setup and procedure is given, and current challenges are discussed.