

Evaluation of material strength in inelastic heterogeneous microstructures: A toolbox for virtual experimentation

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Although a number of tools have been developed for conducting plasticity simulations, these have not yet been assembled into a comprehensive modeling environment exclusively for microstructures. Understanding of strength at the micro-scale would be greatly enhanced by a virtual testing environment where the user can select constitutive models for microstructural components. This software is being implemented in an object-oriented environment and includes meshing capabilities of the NIST software OOF2, and parallel finite element processing tools. The method of homogenization in the large strain regime will be utilized to calculate the stress-strain response of microstructures consisting of aggregates of grains. Various examples of determining the stress-strain curves for a variety of constitutive models including those based on polycrystal plasticity will be provided. Further, by interrogating a statistically representative set of microstructures instead of an RVE through analysis in the batch mode, it would be possible to model material heterogeneities. The key goals of this environment are to provide engineers with a user-friendly yet powerful environment for conducting a number of virtual tests, with the ultimate goal of designing microstructures with desired strength.