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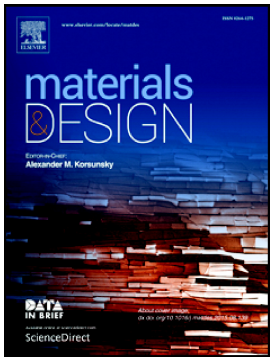

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Influences of size effect and stress condition on ductile fracture behavior in micro-scaled plastic deformation

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Abstract

In macro-scaled plastic deformation, ductile fracture behaviors have been extensively investigated in terms of formation mechanism, deformation mechanics, influencing factors and fracture criteria. In micro-scaled plastic deformation, however, the fracture behaviors of materials are greatly different from those in macro-scale due to the existence of size effects. To explore the simultaneous interaction of size effect and stress condition on material fracture behaviour in meso/micro-scaled plastic deformation, the tensile and compression tests of pure copper with various geometrical sizes and microstructures were conducted. The experiment results show that microvoids exist in compressed samples due to localization of shear band instead of macro fracture. Furthermore, the FE simulation is conducted by using the size dependent surface layer model, which aims to study the interaction of size effect and stress condition on material fracture behavior in multi-scaled plastic deformation. It is found that the stress triaxiality (T) generally increases with the ratio of surface grains η in compression statement. Fracture strain and fracture energy with positive T are much smaller than that with negative T regardless of geometrical and grain sizes. This research provides an in-depth understanding of the influences of size effect and stress condition on ductile fracture behavior in micro-scaled plastic deformation.

Keywords: Size effect; Stress condition; Ductile fracture; Micro-scaled plastic deformation.