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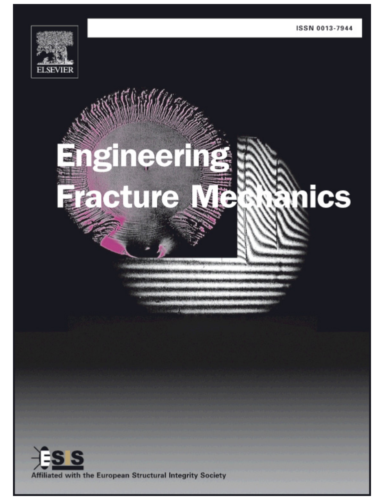

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Effect of loading conditions on nucleation of nano void and failure of nanocrystalline aluminum: an atomistic investigation

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Abstract

Deformation mechanism, nano void nucleation and failure of nano crystalline aluminum are investigated for uniaxial, plane strain and equi biaxial loading conditions using atomistic simulation technique. Nano deformation twin formation is noticed for all three loading conditions. Grain boundary triple point is the site of nano void nucleation and the fracture mode is intergranular type. Early nano void nucleation and failure are observed in plane strain loading condition in comparison with uniaxial and equi biaxial loading conditions.

Key words nano crystalline aluminum, LAMMPS, nano void nucleation, nano deformation twin, intergranular fracture

Introduction

A polycrystalline material with a crystallite size of only a few nanometers is normally defined as nanocrystalline material. A crystallite grain size below 100 nm material is commonly defined as nanocrystaline material. Grain sizes from 100–500 nm are usually designated as ultrafine grains. nanocrystaline metallic materials have been extensively investigated due to their superior mechanical, optical, and electrical properties [1]. Several techniques are present to reduce the grain size to nano-scale, they are: severe plastic deformation (SPD) [2] techniques, e.g., equal channel angular processing (ECAP) [3], high pressure torsion (HPT) [4], accumulative roll bonding (ARB) [5], and ball milling [6] etc. Nano scale grain boundaries and other defects (e.g., point defects, twinning, stacking fault and porosity) present in nanocrystaline structure generated