# Modeling of grain-boundary mediated viscoplasticity in nanocrystalline Al/a-Al2O3 laminate system

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**Abstract**

Finite element (FE) modeling is used to simulate the occurrence of plastic localization observed by transmission electron microscopy (nanoDIC) at the boundaries of aluminum nanocrystals inside an Al/Al2O3/Al three-layer laminate composite (with a total thickness of 300nm) that is subjected to in situ uniaxial tension. When loaded at low-strain rate (10-6 s-1), such composite exhibits huge strength (UTS> 1.5 GPa) and significant ductility (in spite of the presence of a brittle metal oxide layer) (1). The confrontation of model predictions to experimental observations indicates that both the composite tensile response and the heterogeneous strain field inside individual layers may be explained based on diffusion-controlled, rate-dependent deformation mechanisms operating in the vicinity of grain boundaries within the Al layers. The local diffusion fluxes and their contribution to the macroscopic strain are estimated as a function of the GB tilting relative to the tensile axis.

**Keywords:** diffusion, grain boundary sliding, migration

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