Mechanical Properties of a Cu$_{46}$Zr$_{54}$ Bulk Metallic Glass with Embedded Nanocrystal Particles

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ABSTRACT

Plasticity in bulk metallic glasses (BMGs), is normally dominated initially by shear transformations zones (STZ), which expand to form shear bands (SB) through the material. In order to control and thus improve the dynamics of plasticity, the composition of the metallic glasses is modified in different ways [1-3]. Particularly, the inclusion of nanocrystals provides obstacles to SB propagation and growth, with SB often nucleating at the interface between the BMG and the nanoparticle [1]. This results in a reduced and more homogeneous deformation in the plastic regime. Nevertheless, to ensure lasting effects, the inclusions should be stable in time, i.e. not diffuse into the surrounding amorphous material loosing the sharp transition from crystal to amorphous.

In previous work [5] we determined constitutive parameters of the Cu$_{46}$Zr$_{54}$ metallic glass as a function of temperature, using atomistic Molecular Dynamics (MD) simulations. We will now present results for two different types of inclusions: FCC copper and B2-CuZr sphere-shaped nanocrystals. Although we won't focus on the size effects of inclusions like other works [3-4], we analyse the stability of the nanoparticles at different temperatures. During mechanical deformation of a BMG sample with inclusions, we analyze Voronoi polyhedra, and shear stress and shear strain localization to study the role of the inclusion in the mechanical properties of this composite material.

REFERENCES