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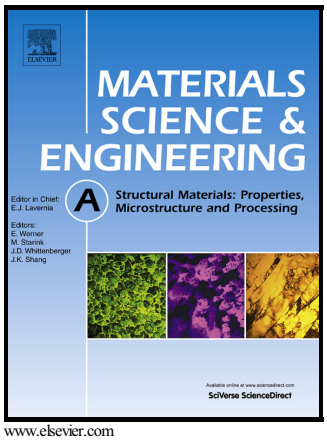

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Mechanical properties of a high strength Cu-Ta composite at elevated temperature

K.A. Darling[1*], E.L. Huskins[1,+], B.E. Schuster[1], Q. Wei[2], and L.J. Kecskes[1]

[1] U.S. Army Research Laboratory, Weapons and Materials Research Directorate, RDRL-WMM-F, Aberdeen Proving Ground, MD 21005-5069, USA

[2] Department of Mechanical Engineering and Engineering Science, University of North Carolina at Charlotte, Charlotte, NC 28223, USA

Abstract

Nominally pure nanocrystalline metals do not remain nanostructured under extreme conditions of intense heating and or deformation preventing the study of their physical response under such conditions. Here we present the coupled effect of temperature and strain rate on the mechanical response of a thermally stabilized nanocrystalline Cu alloyed with 10 at% Ta. Compressive mechanical testing was performed from 24 to 1000 °C and strain rates ranging from quasi-static (10^{-1} s^{-1}) to dynamic (~10^{4} s^{-1}) rates. The response of this material exhibits a maximum quasi-static yield stress of 1.05 GPa at room temperature and an approximate yield stress of 0.5 GPa at 600 °C, with an apparently linear temperature response. In contrast to pure coarse-grained Cu, our assessment indicates that this Cu-based composite derives its properties from a combination of very small Cu-rich grains and well-dispersed Ta clusters and nanometer (<10 nm) size Ta precipitates. Such microstructural features translate into a strong resistance to coarsening even after extensive exposure to elevated temperatures and high rates of deformation.

Keywords

Nanocrystalline alloys, Cu-Ta alloys, thermal-strain rate effect, dynamic compression test.

* Corresponding author.

+ Currently at the Mechanical Engineering Department, United States Naval Academy, Annapolis, MD 21402.

Corresponding Author Contact info

* Kristopher Allen Darling
Phone number: 410-306-0862
Fax number: 410-306-1407
Email: Kristopher.darling.civ@mail.mil