Accepted Manuscript

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PII: S1044-5803(17)33582-9
DOI: doi:10.1016/j.matchar.2018.04.051
Reference: MTL 9191

To appear in: *Materials Characterization*

Received date: 19 December 2017
Revised date: 24 April 2018
Accepted date: 27 April 2018

Please cite this article as: Dinc Erdeniz, Anthony De Luca, David N. Seidman, David C. Dunand , Effects of Nb and Ta additions on the strength and coarsening resistance of precipitation-strengthened Al-Zr-Sc-Er-Si alloys. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Mtl(2017), doi:10.1016/j.matchar.2018.04.051

Effects of Nb and Ta Additions on the Strength and Coarsening Resistance of Precipitation-Strengthened Al-Zr-Sc-Er-Si Alloys

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Abstract

A dilute Al-0.07Zr-0.02Sc-0.005Er-0.06Si (at.%) alloy was microalloyed with 0.08 at.% Nb or Ta. Atom-probe tomography reveals that, upon aging, Nb and Ta partition to the coherent $L1_2$-$Al_3(Zr,Sc,Er)$ nanoprecipitates (with average concentrations of 0.14 and 0.09 at.%, respectively), with both segregating at the matrix/nanoprecipitate heterophase interface. This is consistent with the Nb- and Ta-modified alloys exhibiting, as compared to the unmodified alloy: (i) higher peak microhardness, from a higher nanoprecipitate volume fraction and/or lattice parameter mismatch; and (ii) improved aging resistance, from slower nanoprecipitate coarsening due to the small diffusivities of niobium and tantalum in aluminum. Analogous results were previously reported for a V-modified alloy.

Keywords: Aluminum alloys; Precipitation strengthening; Coarsening; Microhardness; Atom-probe tomography

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