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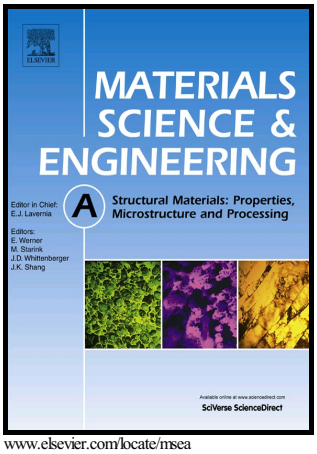

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PII: S0921-5093(17)30592-0
DOI: http://dx.doi.org/10.1016/j.msea.2017.04.111
Reference: MSA35012

To appear in: *Materials Science & Engineering A*

Cite this article as: Z.G. Wang, W. Zhou, L.M. Fu, J.F. Wang, R.C. Luo, X.C. Han, B. Chen and X.D. Wang, Effect of coherent $L1_2$ nanoprecipitates on th tensile behavior of a fcc-based high-entropy alloy, *Materials Science & Engineering A,* http://dx.doi.org/10.1016/j.msea.2017.04.111

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Abstract

Effect of coherent $L1_2$ nanoprecipitates on the tensile behavior of a novel-designed $Al_{0.2}CrFeCoNi_2Cu_{0.2}$ high-entropy alloy is investigated in this study. Different heat treatments after cold rolling were used to achieve the alloys with two different microstructures. One is composed of a fcc matrix and coherent $L1_2$ $(Ni,Cu)_3Al$ nanoprecipitates after annealing at 700°C for 20h; the other owns a fcc single-phase structure after annealing at 800°C for 1h as reference. Furthermore, the two alloys have nearly identical average grain sizes (~4.5 um), and thus the exclusive effect of $L1_2$ nanoprecipitates could be identified by directly comparing their tensile behaviors. It is shown that the presence of $L1_2$ nanoprecipitates results in increases of 259 MPa and 316 MPa in the yield strength and ultimate tensile strength, respectively, accompanied by the maintenance of a high elongation (30.4%). This excellent strengthening effect is explained by the interaction between dislocations and $L1_2$ nanoprecipitates during the tensile straining process. Dislocation shearing of the $L1_2$ nanoprecipitates, which is evidently observed and also verified by the yield strength increment calculation, leads to predominant planar dislocation glide and the formation of crystallographically aligned slip bands as the main deformation mechanism, eventually resulting in a considerable work-hardening capacity enhancement with almost none harm to the elongation.

Keywords: High-entropy alloy, Precipitation-hardening, Work-hardening, Slip band