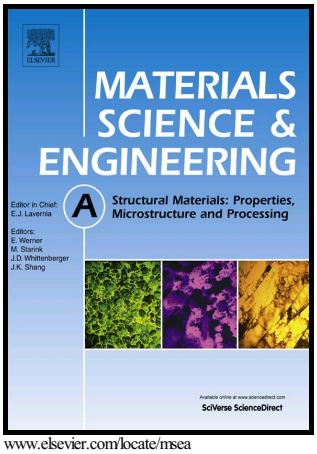
Author's Accepted Manuscript

Orientation and Temperature Dependence of a Planar Slip and Twinning in Single Crystals of $Al_{0.3}CoCrFeNi$ High-Entropy Alloy

I.V. Kireeva, Yu.I. Chumlyakov, Z.V. Pobedennaya, A.V. Vyrodova, I.V. Kuksgauzen, Kuksgauzen



www.elsevier.com/locate/msea

PII: S0921-5093(18)31221-8
DOI: https://doi.org/10.1016/j.msea.2018.09.025
Reference: MSA36906

To appear in: *Materials Science & Engineering A*

Cite this article as: I.V. Kireeva, Yu.I. Chumlyakov, Z.V. Pobedennaya, A.V. Vyrodova, I.V. Kuksgauzen and Kuksgauzen, Orientation and Temperature Dependence of a Planar Slip and Twinning in Single Crystals of $Al_{0.3}CoCrFeNi$ High-Entropy Alloy, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.09.025

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Orientation and Temperature Dependence of a Planar Slip and Twinning in Single Crystals of $Al_{0.3}CoCrFeNi$ High-Entropy Alloy

I.V. Kireeva, Yu.I. Chumlyakov, Z.V. Pobedennaya, A.V. Vyrodova, I.V. Kuksgauzen, D.A. Kuksgauzen

National Research Tomsk State University, Siberian Physical-Technical Institute of V.D. Kuznetsova, Novosobornaya Sq.1, Tomsk 634050, Russia
*Corresponding author: kireeva@spti.tsu.ru

Abstract

This paper repots the effect of crystal orientation and test temperature on the tensile deformation behaviour, the type of dislocation structure (planar or cellular) and the deformation mechanism (slip and twinning) in single crystals of the fcc $Al_{0.3}CoCrFeNi$ (at.%) high-entropy alloy. It was shown that, in the temperature range 77-573K, the tensile deformation behaviour at 0.1 % <ε < 15 % along [001], [$\bar{1}$11] and [011] orientations is related to the slip, at which a planar structure with dislocation pile-ups develops in the wide temperature range of 77-423 K. The planarity of the dislocation structure is determined by the strong effect of solid-solution hardening via Al atoms, since the effective radius of Al atoms exceeds the effective radii of the other elements included in the composition of the $Al_{0.3}CoCrFeNi$ alloy, and existence of short-range order. In slip deformation, the strain hardening coefficient in the linear stage of hardening, i.e., $\Theta_{II}(T)/G(T)$, depends on the crystal orientation and the test temperature. In the [011]-oriented single crystals where the slip deformation develops predominantly in one system, $\Theta_{II}(T)/G(T)$ has small values and it increases with an increasing number of active slip systems in the [$\bar{1}$11]- and [001]-oriented single crystals. Twinning was detected at 77 K in the [$\bar{1}$11]- and [011]-oriented single crystals after 15 and 20%, respectively. Deformation twinning in the [$\bar{1}$11]- and [011]-oriented single crystals leads to an increase in $\Theta_{II}(T)/G(T)$ and determines more complex deformation stages in the σ–ε curve in the [011]-oriented single crystals compared with the development of slip deformation at high test temperatures.

Keywords: $Al_{0.3}CoCrFeNi$ high-entropy alloy; Single crystals; Planar slip; Deformation twinning; Stages of deformation under tensile strain.

Accepted manuscript

1. Introduction

In the recent years, the $Al_{0.3}CoCrFeNi$ high-entropy alloy (HEA) with medium stacking fault (SF) energy, γ_0=0.051 J/m^2, whose chemical composition is located near the phase boundary between the fcc and bcc structures, has of great interest for research due to unique properties similar to the Cantor HEA, such as high tensile strength and ductility at room and cryogenic temperatures [1-16]. The peculiarity of this alloy in comparison with the Cantor HEA is, firstly, that due to Al alloying, a higher level of stress in the yield point is achieved, since the size of Al

Download English Version:

https://daneshyari.com/en/article/10155884

Download Persian Version:

https://daneshyari.com/article/10155884

Daneshyari.com