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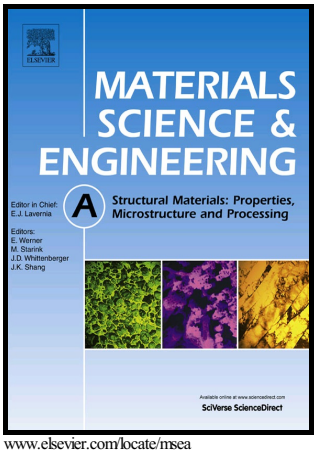

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PII: S0921-5093(17)30853-5
DOI: http://dx.doi.org/10.1016/j.msea.2017.06.086
Reference: MSA35224

To appear in: *Materials Science & Engineering A*

Received date: 20 March 2017
Revised date: 9 June 2017
Accepted date: 22 June 2017

Cite this article as: Igor Moravcik, Jan Cizek, Zuzana Kovacova, Jitk Nejezchlebova, Michael Kitzmantel, Erich Neubauer, Ivo Kubena, Vit Hornil and Ivo Dlouhy, Mechanical and Microstructural Characterization of Powde Metallurgy CoCrNi Medium Entropy Alloy, *Materials Science & Engineering A* http://dx.doi.org/10.1016/j.msea.2017.06.086

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Abstract

The present study is focused on synthesis and mechanical properties characterization of equiatomic CoCrNi medium entropy alloy (MEA). Powder metallurgy processes of mechanical alloying (MA) with subsequent spark plasma sintering (SPS) for bulk alloy densification have been utilized. As opposed to the single-phase alloys of identical composition fabricated via casting routes, the alloy after SPS compaction consisted of a major FCC solid solution phase (94.4%), minor fraction of secondary BCC phase (5.6%, precipitated at the FCC grains boundaries), and negligible amount of oxide inclusions. The alloy exhibited high ultimate tensile strength of 1024 MPa and a elongation to fracture of 26 %. Elastic modulus of the alloy reached 222 GPa and the thermal expansion coefficient (CTE) was measured as $17.4x10^{-6}$ K^{-1} The plastic deformation in the alloy is carried out by a combination of dislocation glide and mechanical nano-twinning at room temperature.

Keywords:

tensile test, mechanical alloying, plasticity, mechanical characterization, powder metallurgy

1. Introduction

Yeh et al. [1] came up with an idea of an equiatomic alloy comprising of five elements displaying simple solid solution microstructure. Cantor et al [2, 3] simultaneously developed alloys following the same concept. This new class of metallic materials was denoted as high entropy alloys (HEA). They generated considerable interest in the scientific community, deriving their properties not from a single dominant element, but from a multiple elements arranged in a single cubic lattice. Over the time, a number of various alloy systems have been examined, exhibiting many intriguing properties, such as extremely good combination of strength and ductility [4-7], high temperature strength [8, 9], wear resistance [10-12], creep [13] etc.

Considering these, it is not surprising to learn that high expectations are being put into the development of these new materials. However, most of the alloys in the presented studies derive from the original one solid solution concept (i.e., the currently acknowledged basic HEA principle) as they exhibit multiphase structures. In fact, it has been proposed by Wu et al. [14] that the idea of stabilization of a simple solid solution by the increase of configurational entropy by the addition of more elements to the alloy may be