World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:16, No:03, 2022

High Pressure Torsion Deformation Behavior of a Low-SFE FCC Ternary Medium Entropy Alloy

Authors : Saumya R. Jha, Krishanu Biswas, Nilesh P. Gurao

Abstract : Several recent investigations have revealed medium entropy alloys exhibiting better mechanical properties than their high entropy counterparts. This clearly establishes that although a higher entropy plays a vital role in stabilization of particular phase over complex intermetallic phases, configurational entropy is not the primary factor responsible for the high inherent strengthening in these systems. Above and beyond a high contribution from friction stresses and solid solution strengthening, strain hardening is an important contributor to the strengthening in these systems. In this regard, researchers have developed severe plastic deformation (SPD) techniques like High Pressure Torsion (HPT) to incorporate very high shear strain in the material, thereby leading to ultrafine grained (UFG) microstructures, which cause manifold increase in the strength. The presented work demonstrates a meticulous study of the variation in mechanical properties at different radial displacements from the center of HPT tested equiatomic ternary FeMnNi synthesized by casting route, which is a low stacking fault energy FCC alloy that shows significantly higher toughness than its high entropy counterparts like Cantor alloy. The gradient in grain sizes along the radial direction of these specimens has been modeled using microstructure entropy for predicting the mechanical properties, which has also been validated by indentation tests. The dislocation density is computed by FEM simulations for varying strains and validated by analyzing synchrotron diffraction data. Thus, the proposed model can be utilized to predict the strengthening behavior of similar systems deformed by HPT subjected to varying loading conditions.

Keywords : high pressure torsion, severe plastic deformation, configurational entropy, dislocation density, FEM simulation
Conference Title : ICHEAM 2022 : International Conference on High-Entropy Alloys and Materials
Conference Location : Dubai, United Arab Emirates
Conference Dates : March 21-22, 2022

Open Science Index, Materials and Metallurgical Engineering Vol:16, No:03, 2022 publications.waset.org/abstracts/144234.pdf