Poster Presentation

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Structure of laves phase in equiatomic CrFeNbNiV alloy

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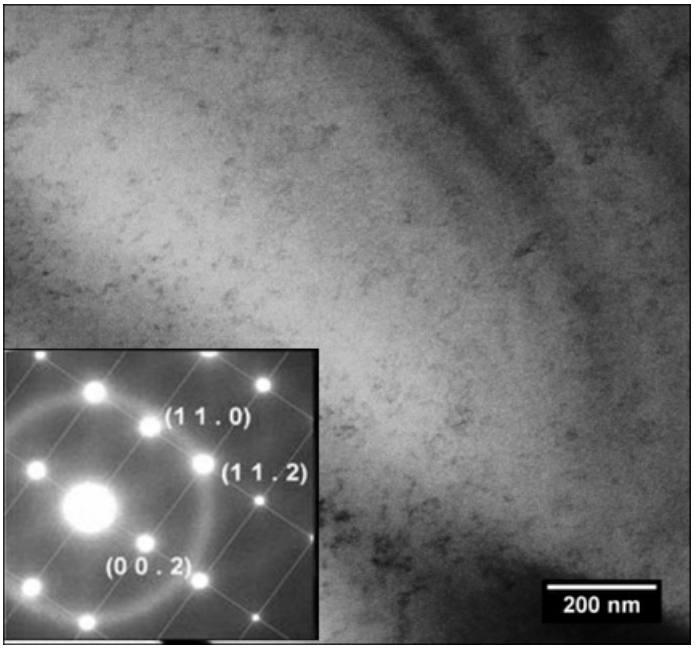
Multiprincipal elemental alloys commonly referred to as High Entropy Alloys (HEA) are a relatively new class of materials gaining large interest in recent times due to their new microstructures and excellent mechanical and corrosion properties. An equiatomic high entropy Cr-Fe-Ni-Nb-V alloy synthesized by multiple vacuum arc melting. Though the formation of BCC solid solution was predicted by considering the thermodynamic parameters like entropy and enthalpy of mixing, atomic size differences, valence electron concentration and electronegativity [1], analysis of XRD pattern of the as cast alloy, showed the presence of a major HCP Laves phase of CrNiNb type and minor tetragonal and BCC phases. The lattice parameters of these phases calculated by Rietveld refinement are as follows: (i) HCP Laves phase: a=0.485 ± 0.003 & c= 0.790 ± 0.009 nm (ii) BCC phase: a=0.327 ± 0.001 nm (iii) Tetragonal phase: a= 0.895 ± 0.002 & c= 0.462 ± 0.002 nm. Microstructural and microchemical analysis through Transmission Electron Microscopy confirmed that the HCP Laves phase is Nb rich, while the tetragonal and BCC phases are lean w.r.t Nb and enriched with Cr and V. The microstructure of the alloy was found to be stable upto 1100°C. Bright field TEM image of the Laves phase of this alloy aged at 1100°C along with the Selected Area Diffraction Pattern along [-11.0] zone axis from the Laves phase is shown in the figure below. The formation of HCP Laves phase in contrast to the theoretical predictions was understood based on the calculation of average d orbital energy level, which decides the formation of topological close packed phases in superalloys containing transition elements [2]. Since HEAs also contains transition elements, this concept is extended to these novel alloys. For the current alloy, the average d- orbital energy level was calculated to be 1.46, which is well above the threshold value of 1.09 for formation of intermetallic phases. This dictates the formation of intermetallic Laves phases in this system. Detailed analysis regarding the crystallographic aspects of this Laves phase using Rietveld refinement and Precession Electron Diffraction (PED) technique is under progress, results of which will be presented in the paper.

[1] Sheng, G., Liu, C.T. (2011). PROG NAT SCI-MATER, 21, 433-446.
[2] Yiping Lu. et al. (2015). Entropy, 17, 2355-2366.



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