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Effects of Nickel Content on the Microstructure, Microhardness and Corrosion Behavior of High-entropy AlCoCrFeNi$_x$ Alloys

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Abstract:
The pioneering efforts in obtaining the high entropy alloys (HEAs) created the groundwork for a new concept in alloy design by finding new equiatomic combinations of elements for advanced materials with unique properties.
In this study we investigate the effect of different nickel concentration on the microstructure, hardness and corrosion properties of high entropy alloys from AlCrFeCoNi system.
The analyzed HEAs were AlCrFeCoNi$_x$ with x=1; 1.4 and 1.8. These alloys were obtained by vacuum arc remelting from raw materials with high purity.
The microscopy examination has revealed the dendritic morphology for the reference alloy (AlCrFeCoNi) and the increase of the width of the interdendritic zones by increasing the nickel concentration while Cr is segregated in the interdendritic regions more than in dendrites.
Hardness values decrease with increasing the percentage of nickel because of the dissolution of precipitates in a nickel rich matrix and in consequence forming continuous solid solutions.
The corrosion properties of the HEAs were evaluated using a potentiodynamic polarization method. The alloys were immersed in SBS (Simulated Body Fluid) during one week and the corrosion parameters were registered. The low corrosion rates, low corrosion currents and high polarization resistance attest the good stability of HEAs in simulated biological environment.

Keywords: high entropy alloys, nickel, corrosion resistance, corrosion currents, polarization resitance, passivation, Ringer solution.

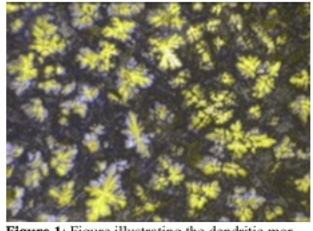

Figure 1: Figure illustrating the dendritic mor - phology of high-entropy AlCrFeCoNi$_{1.4}$ alloy after electrochemical etching in oxalic acid 10% for one minute.

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