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**AlNiCoFeCrTiB_x HIGH-ENTROPY ALLOY COATINGS RESULTED
FROM ELECTRON BEAM WELDING**

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In many situations, only the contact surface properties are important in determining performance of the component in practical applications. Therefore, the use of a coating from materials with high physical and mechanical characteristics, such as high-entropy alloys (HEA) [1-3], has several attractive advantages. HEAs have been found to have novel microstructures and unique properties. At the same time, by controlling the composition of HEA, it is possible to achieve high hardness, wear resistance, corrosion resistance, oxidation resistance, high temperature performance [2, 3]. Nowadays the primary method to synthesize HEAs is vacuum arc remelting for bulk cast ingot, surface coating and mechanical alloying is also possible [2-4]. Considering HEA's tendency to form simple structures, fabricating HEA coating by electron beam welding process is of great significance and potential for extensive use. Until now this novel method for preparing HEA coatings has just been reported by any organizations.

The purpose of this work is to study the features of microstructure, phase and chemical composition, and microhardness of HEA coatings, produced by electron-beam welding on steel substrate of 6 and 7-component powder equiatomic mixtures of the system Al-Ni-Co-Fe-Cr-Ti-B_x. In order to evaluate the influence of B content in AlNiCoFeCrTiB_x, the x factor was set as variable quantity and the experiments were divided into 4 groups: x = 0; 0,25; 0,5 and 1,0. All the elements except B are equiatomic. The microstructure, chemical composition, and constituent phases of the synthesized coatings were characterized by SEM, EDX, and X-ray diffraction (XRD) analysis. Microhardness HV was also evaluated.

Experimental results demonstrate that the AlNiCoFeCrTiB_{0...0,5} HEA coatings are composed of only two substitutional solid solutions with body-centered cubic (BCC) structure and different lattice parameter due to different component concentration. The coatings exhibit dendritic microstructure with different size and morphology. With the increase in the boron content to x = 1, the phase composition changes and in the AlNiCoFeCrTiB coating formation of one bcc solid solution and Cr₂B TiB₂ and BCr_{0,2}Fe_{1,8} borides is observed due to the presence of excess boron atoms, do not dissolve in the void spaces of the bcc crystal lattice of the substitutional solid solution.

The hardness was measured with a load of 100 g. The variation of coating hardness reflects the coating microstructure changes, which are responsible for the hardness variation. The addition of boron (0,25; 0,5; 1) to original mixture AlNiCoFeCrTi leads to distortion of the crystal lattice and increase in hardness from 8,8 GPa to 12,8 GPa and then with a maximum content in AlNiCoFeCrTiB coating due to appearance of borides to 14,2 GPa. The hardness of AlNiCoFeCrTiB_{0,25...1} high entropy coatings is much higher than that of the initial components and than the one of the steel substrate, and is much higher than that of the similar alloys prepared by laser cladding technique [5] and is due to the combined effects of solid-solution strengthening and to the presence of a large quantity of hard boride particles in the microstructure.

References:

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