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BOOK OF ABSTRACTS

СБОРНИК ТЕЗИСОВ ДОКЛАДОВ

МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РФ
РОССИЙСКАЯ АКАДЕМИЯ НАУК
ИНСТИТУТ ПРОБЛЕМ СВЕРХПЛАСТИЧНОСТИ МЕТАЛЛОВ РАН
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THE RESEARCH OF MICROSTRUCTURE AND MECHANICAL PROPERTIES OF NON-EQUIATOMIC AlCoCrFeNi HIGH ENTROPY ALLOY FABRICATED WIRE-ARC ADDITIVE MANUFACTURING

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High entropy alloys (HEAs) is a multi-component alloy design concept, proposed in 2004 . Compared to conventional alloys, which contain one and rarely two base elements, these metallic alloys usually contain five or more principal elements with amounts ranging from 5 to 35 at.%. HEAs fabrication technologies could be classified into four, namely, solid-state processing technique, liquid state processing, thin-film deposition techniques, and additive manufacturing technology. Among these methods, additive manufacturing technologies are the most promising for fabrication bulk materials since they can produce complex structures from a computer-aided design model in short delays without expensive tools such as molds. Wire-arc additive manufacturing (WAAM) attracts interest in the fabrication of large-sized parts with a high deposition rate and low equipment costs. This technology is generally used with a single wire that constrains the ability to use it to produce HEAs.

The current study suggested reducing the number of filaments by using multi-component wires from high-precision alloys, which cost less than high-purity filaments. Therefore, the purpose of the present work was to fabricate Al-Co-Cr-Fe-Ni bulk high-entropy alloy via wire-arc additive manufacturing, using a combination of high-precision alloy filaments and a pure Al wire. Microstructure, elemental and phase composition, as well as mechanical properties of the fabricated material, were investigated in this work. Manufacturing of HEA samples was carried out by layer-by-layer deposition on a steel substrate using wire-arc additive manufacturing technology in a shielding gas atmosphere. The following process parameters were used: wire feed speed 8 m/min, voltage 17 V, travel speed 0.3 m/min, substrate heating temperature ≈250 °C. The resulting HEA had dimensions of 60x140x20 mm^3 and consisted of 20 deposited layers in height and 4 layers in thickness.

According to EDS results, the top, middle, and bottom areas of the manufactured HEA have almost equal element composition. The total element composition of the system is the following: Al – 35.67±1.34 %, Co – 4.99±0.09 %, Cr – 8.28±0.15 %, Fe – 17.28±1.83 %, Ni – 33.79±0.46 %. These results demonstrate that the fabricated bulk material is a non-equimolar Al2.1Co0.3Cr0.5FeNi2.1 high entropy alloy with high amount of Al and Ni elements. The XRD analysis determined the A2 and B2 phases in the top, middle and bottom areas of the sample. The lattice parameters are the same for A2 and B2 phases, a = 0.28914 nm. Al-Co-Cr-Fe-Ni HEA thick-walled component was fabricated via wire-arc manufacturing technology using combined cable wire as a wire feed. The sample with multilayer structure was composed of dendrite grains ranging from 5 to 15 μm and interdendritic regions. The obtained component had good mechanical properties, high microhardness, nanohardness, and elastic modulus, comparable to other alloys' performance with a similar chemical composition, indicating that this technique is suitable for manufacturing high entropy alloys.

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