

Development of a new powder-bed arc additive manufacturing approach for producing high entropy alloys

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Abstract

High entropy alloys (HEAs) have gained significant attention over the past decade from both academic and industrial communities due to their unique design concept and promising properties. The manufacturing of this emerging material with desired properties remains challenging. A new powder-bed arc additive manufacturing (PAAM) has been developed at the University of Wollongong for producing HEAs. This approach, with a high level of flexibility for controlling the forming process and the characteristic rapid solidification, enables the tailoring of the microstructure through the process control and the effective reduction of the chemical segregation in these compositionally complexed alloys. Additionally, compared with the laser and electron beam based additive manufacturing, PAAM is advantageous for higher production rate hence it is promising in industrial applications for producing bulk components in shorter period. The production of a eutectic AlCoCrFeNi_{2.1} HEA using this new PAAM approach will be presented to demonstrate its capability. Then, the FeCr_{0.4}V_{0.3}Ti_{0.2}Ni_{1.3} HEA with low neutron cross-section is successfully designed and fabricated in this system. The good tensile properties of this novel HEA make it become a potential candidate as a structural material in the future nuclear industry.

Keywords: Additive manufacturing; High entropy alloy; Mechanical properties; Microstructure