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Development of A New Powder-bed Arc Additive Manufacturing Approach for Producing High Entropy Alloys

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. Most of previous work utilized conventional vacuum arc melting and casting methods for producing HEAs. However, the disadvantage of typical casting microstructure, columnar dendrite and serious chemical segregation, causes serious deterioration to their mechanical properties. 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. The characterisation work shows that the produced AlCoCrFeNi_{2.1} samples have a lamellar microstructure consisting of the soft but ductile face-centered cubic (FCC) phase as well as the hard body-centered-cubic (BCC) phase. The material demonstrates a remarkable combination of excellent ultimate tensile strength (719 MPa) and ductility (elongation ~27%). The current work has demonstrated that the developed PAAM process is promising for producing HEA components with desired properties.

Presenter Gender

Man

Do you wish to take part in the Student Poster Slam

Condition of submission

Students Only - Are you interested in AINSE student funding

Level of Expertise

Pronouns

Which facility did you use for your research

Australian Centre for Neutron Scattering

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