EBSM 3D printing of high-performance tungsten components: numerical and experimental investigations

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Abstract

Refractory rare metal tungsten (W) material has significant applications in many key industrial areas due to its superior properties. However, how to fabricate high-performance W component with high relative density, complicated geometry, and desired structure is still challenging. Many issues need to be further explored and clarified. Under this circumstance, comprehensive multi-scale numerical investigations were conducted on the EBSM (electron beam selective melting) additive manufacturing (AM, also called 3D printing) of pure W components with lattice structures using coupled DEM-CFD (discrete element method-computational fluid dynamics) model. The material parameters of pure W powders with continuous size distributions utilized in actual AM production were firstly calibrated and input into DEM model for parametric study on powder spreading. Then, the EBSM 3D printing of the spread powder bed of W was simulated by CFD. In the whole process, the cumulative and cooperative effects of the powder layer and the printed area on the whole printing process were systematically discussed. Meanwhile, the underlying mechanisms were analyzed and identified. On this basis, corresponding physical experiments were carried out. The obtained highlighted results can be of both theoretical and practical significances for the design and additive manufacturing of high-performance W components in real process.

Brief Biography

Dr. Xizhong An got his Ph. D degree from the University of Science and Technology Beijing (USTB, China) in 2002 and worked as a postdoc fellow in the University of New South Wales (UNSW, Australia) in 2003-2005. Currently he is the full professor and director in the Institute of Particle Technology, Northeastern University (NEU). Prof. An's research interests include numerical and physical studies on particulate science and powder engineering, granular matter, powder metallurgy, refractory metals and alloys, additive manufacturing. In recent years, he has undertaken >30 projects from overseas, governments and enterprises. More than 160 papers were published, including one book chapter and >130 SCI papers in many leading/top international journals. 27 invention patents were authorized. In addition to many honors and awards received, he has also been engaged in many academic/social organizations and played a significant role therein.