ICCES, 2024, vol.31, no.4
DOI: 10.32604/icces.2024.012381

PROCEEDINGS

Advanced Powder Fabrication Techniques for Laser Powder Bed Fusion

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ABSTRACT

Laser powder bed fusion (L-PBF) exhibits many technological opportunities for producing high-performance metallic parts with tailored architectures. However, fabrication of suitable composite powders possessing good flowability, controllable particle size and distribution is a currently prerequisite and main challenge. In this work, two novel techniques, namely freeze-dry pulsated orifice ejection method (FD-POEM) [1] and ultrafine bubble (UFB)-assisted heteroagglomeration [2], have been developed to fabricate uniform composite powders. By taking MoSiBTiC alloy powders as an example, the working principle of FD-POEM process was firstly illustrated. The spherical FD-POEM particles were consisted of typical mesh structures induced by the sublimation of ice crystals, benefiting to enhanced laser absorptivity. In addition, high-concentration, impurity-free nanoceramic/metal composite powders were fabricated using the negatively charged UFBs. Thanks to their bridging effect, individual ZrO_2 or Al_2O_3 nanoparticles up to ~10wt% were homogeneously decorated on the surface of Ti-6Al-4V powders. The nanoceramics were completely decomposed and dissolved into the matrix during L-PBF; thus, a unique Ti nanocomposite exhibiting a high tensile strength of 1.4GPa and an acceptable ductility of 8.1% was fabricated. This work offers new insight into the fabrication of unique L-PBF powders and the mechanical functionalization of metallic parts.

KEYWORDS

Laser powder bed fusion (L-PBF); freeze-dry pulsated orifice ejection method (FD-POEM); ultrafine bubble (UFB); heteroagglomeration; composite powders

Funding Statement: N. Nomura received the financial support from the MEXT Program: Data Creation and Utilization Type Material Research and Development Project, Grant Number JPMXP1122684766.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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