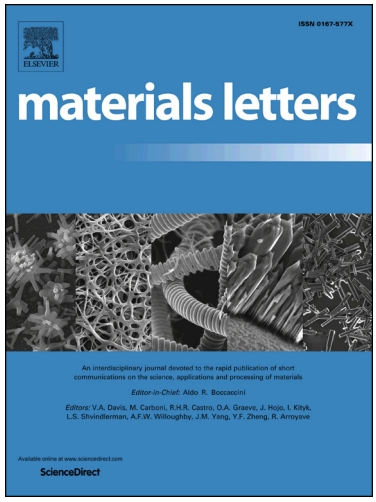

Laser 3D printing of CoCrFeMnNi high-entropy alloy

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Laser 3D printing of CoCrFeMnNi high-entropy alloy

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Abstract:

Due to their superior properties, high-entropy alloys (HEAs) are considered as novel structural materials that can substitute conventional alloys. From the viewpoint of future applications, it is important to explore methods for producing complex shaped and homogeneous HEAs. In this study, laser 3D printing technology is employed to fabricate CoCrFeMnNi HEA. The microstructure and mechanical properties of laser 3D printed HEA are also evaluated. An equiaxed-to-columnar transition structure can be observed in the melt pool of the printed sample. The fine BCC phase is found to distribute at the grain boundaries of the FCC matrix, which is the major phase of the printed sample. The printed HEA exhibits an outstanding combination of high strength and excellent ductility.

Keywords: laser 3D printing; high-entropy alloy; microstructure; laser processing

1. Introduction

High-entropy alloys (HEAs) are a new class of materials that are composed of five or more principal alloying elements in equimolar or near equimolar ratios[1, 2]. This unique alloy design derives the properties of HEAs from multiple principal elements with the potential for combinations of mechanical and physical properties compared with traditional alloys[3, 4]. HEAs are therefore advantageous in many excellent properties [5, 6], which endow HEAs a wide potential applications [7, 8]. However, the main challenge that hinders the practical applications of HEAs is the limitations of fabrication methods[9]. Recently, HEAs are generally synthesized by the arc-melting and casting process. This fabrication route is unlikely to present an industrially suitable way for the production and use of HEAs, since it is difficult to produce HEA component