

Hierarchical nanostructures enabling excellent mechanical properties in CoCrFeNiMn high-entropy alloy additively manufactured by selective laser melting

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High-entropy alloys (HEAs) are a novel class of entropy-stabilized solid solution alloys with five or more principal elements having approximately equiatomic concentrations, which open up a new avenue for the design of materials with optimized properties. The severe lattice distortion and sluggish diffusion that are induced by the mixture of multiple elements endow HEAs with exceptional structure stability and outstanding mechanical properties. However, the current preparations of HEAs rely mainly on the conventional melting or casting methods, imposing enormous limitations to produce samples with complex geometry in terms of cost and efficiency for practical applications. The additive manufacturing (AM) techniques have been recognized as a transformative technology across multiple industries. Based on their advantages of net-shape manufacturing capability and design freedom, it is feasible to harvest parts with complex geometries directly from computer-aided design (CAD) models. In this study, we applied selective laser melting (SLM) technique, which is one of the most popular AM techniques, to prepare a near-fully dense CoCrFeNiMn HEA. The as-built samples exhibit a hierarchical nanostructure, including melt pools, columnar grains, dislocations, and sub-micron cellular structures. An outstanding combination of high strength and excellent ductility compared to those fabricated by conventional methods was achieved in the as-built samples. The detailed deformation behaviour and strengthening mechanism will be discussed in this talk.