Additive Manufacturing of NiTi-based Shape Memory Alloys: State-of-the-Art and Future Perspectives

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ABSTRACT

Based on their unique thermomechanical properties of superelasticity and shape memory effect, low stiffness, damping behavior, biocompatibility and corrosion resistance, NiTi alloys are attractive in a wide range of engineering applications like smart functional structures, medical devices, MEMS and aerospace amongst others. But their poor machinability, high work-hardening rate and reactivity, make them difficult to process and limit their production by conventional techniques to simple geometries like rods, bars, wires, sheets and tubes [1]. In this regard, the potential of additive manufacturing (AM) lies in the production of near-net-shape devices with high complexity and porous/lattice structures [2-3]. Especially, for the production of biomedical scaffold implants these techniques attract a lot of interest, e.g. porous parts can be designed with low effort in order to tailor mechanical properties so that they resemble those of human bone [4].

The aim of this work is to present the state-of-the-art of NiTi alloys produced by additive manufacturing processes. An overview about the various materials, processing techniques and characterization methods, that are commonly applied in recent research works and reports on how additive manufacturing affects microstructure, transformation temperatures and mechanical properties of shape memory alloys, will be provided. Furthermore, advantages, challenges and drawbacks emerging from AM processing will be introduced and discussed.

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