Printability of Mo-Si-B alloys by laser-based additive manufacturing

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Mo-Si-B alloys are promising materials for challenging ultra-high temperature structural applications, e.g. turbine blades in gas turbines. Different fabrication methods for such high melting alloys were investigated in the past, e.g. conventional powder metallurgical processes and solidification processes. However, there are restrictive constraints using such methods, e.g. the size and the geometry of the semi-finished products as well as the essential post-machining to produce the final components.

The use of additive manufacturing processing would enable a more efficient and resource-saving process, though, the processing by additive or generative techniques is very challenging due to the ultra-high melting point beyond 2000°C and the complex solidification behavior of three constituents. This presentation shows the properties of gas atomized Mo-Si-B powders tailored for laser-based additive manufacturing processes, i.e. Laser Powder Bed Fusion and Directed Energy Deposition. The printability of Mo-Si-B powders is demonstrated and a typical layer-wise microstructure evolution is observed in the builds. Pre-heating was found to be mandatory for the production of crack-free samples with very low residual porosity. The compact builds are investigated in terms of their microstructural evolution and the thermal stability. Important mechanical properties like hardness, brittle-to-ductile-transition temperature and creep resistance at temperatures around 1100°C will be presented. Furthermore, the oxidation behavior of the alloys at different temperatures is comparatively discussed with regard to powder metallurgically processed Mo-Si-B materials.