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Taylor-Made Net-Shape Composite Components by Combining Additive Manufacturing and Hot Isostatic Pressing

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A promising production route for high quality taylor-made parts can be established by combining Additive Manufacturing (AM) and Hot Isostatic Pressing (HIP): With the help of a numerical simulation routine, the geometry of the parts prior to HIP is calculated. These geometry-optimised parts are built by Laser Beam Melting (LBM) and consolidated by HIP. After HIP they exhibit a net-shape form that requires only little or even no post-processing at all.

In this study, open thin-walled capsules are manufactured by LBM, filled conventionally with metal powder, evacuated and sealed and hot-isostatically pressed. By this processing route, it is possible to use different materials for the capsule and the powder filling. If capsule and bulk material are identical, the expensive removal of the capsule after HIP can be omitted. By using two different powders, it is possible to produce composite components with a core of high strength and toughness and a wear- or corrosion-resistant surface layer, offering an alternative and competitive production route to conventional HIP cladding.

Here three materials are investigated in different combinations: austenitic stainless steel AISI 316L (X2CrNiMo17¬ 13-3), martensitic tool steel AISI L6 (55NiCrMoV7) and the wear resistant high carbon steel X245VCrMo8-5-1. A number of technical challenges need to be addressed: the production of dense, thin-walled capsules by LBM; LBM of carbide rich steels; diffusion control between corrosion resistant steel and carbon steel; and sealing of capsules made of materials that cannot be welded.

The success of the new process route is demonstrated by metallographic and geometrical investigations.

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Materials

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