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Multi-material steel assemblies by EB-PBF

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There is a growing interest in adapting various metal additive manufacturing (AM) technologies to produce multi-material components. This is particularly appealing in the tooling industry, where combining properties like hardness, corrosion resistance, and toughness from different alloys within a single tool can greatly enhance performance. Significant efforts have been made to adapt powder bed fusion (PBF) techniques for multi-material fabrication. In electron beam-based processes (PBF-EB), beam parameters can be precisely controlled at specific points in the build area. This layer-by-layer control allows for precise melting and solidification, enabling adaptive processes that incorporate powders of different compositions. In this study, two steel-based powders, X40CrMoV12-2 and X35CrMoV5-2 provided by Uddeholms AB, were used to create multi-material tooling assemblies. The process involves loading each hopper with a different metal feedstock, which is dispensed layer-by-layer into the powder bed. The result is crack-free, multi-material specimens with various assemblies. Tailored heat treatments were applied to optimize material properties, and their effects on microstructure and micromechanical performance were evaluated. Characterization of the specimens was conducted in both the as-built and heat-treated states using techniques such as optical microscopy (OM), scanning electron microscopy (SEM), SEM-EDX, and nanoindentation.

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