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Influence of heat treatment and scan rotation on the microstructure of hot work steel manufactured using L-PBF

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Additive manufacturing (AM) provides a unique opportunity to have freedom in design. Often it is necessary to perform post treatment processes on the printed component to adjust the mechanical properties. This is particularly true for martensitic H13 tool steels manufactured with laser-powder bed fusion (L-PBF) where repeated thermal cycles as the result of the addition of the new top layer, can give rise to columnar growth and microstructural inhomogeneities. Considering the unit size and texture of martensitic microstructure as directly under influence of the size of the prior austenite grains (PAGs), the focus of the investigation lies in the PAG size of the as-built (AB) and heat-treated (HT) conditions. Furthermore, four types of samples with different scan rotations (0˚, 45˚, 67˚, and 90˚) were investigated. The AB material displayed a characteristic cell structure with cell boundaries enriched in alloying elements as well as nano-sized carbides at triple joints and intercellular regions. A key finding of this research is tha the heat treatment gives rise to PAG size refinement as the result of recrystallization and pinning effect from carbide hindering the grain growth during austenitization.

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Primary authors: PANAHI, Negar (Uddeholm AB); LIN, Fengxiang (Karlstad university); OIKONOMOU, Christos (Uddeholms AB); GREHK, Mikael (Karlstad University)

Presenter: PANAHI, Negar (Uddeholm AB)

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