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Microstructure and mechanical properties of selective laser melted Ti-3Al-8V-6Cr-4Zr-4Mo compared to Ti-6Al-4V

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Abstract:

Beta Ti-alloys are known for their high fracture toughness and ductility, and are used in applications where these properties are needed, such as the aerospace and biomedical industries. The selective laser melting of the alpha + beta Ti-6Al-4V alloy has been extensively studied for applications in the aerospace industry. Although there has been success in building small parts, the acicular α' microstructure becomes a problem when large parts ($800 \times 400 \times 500 \text{ mm}^3$) are built. The acicular α' microstructure of Ti-6Al-4V causes low fracture toughness and low ductility (<10% elongation), which causes the parts to warp and delaminate from the base plate, even before completion, due to the stress build-up. This work investigated the microstructure and mechanical properties of the beta titanium alloy Ti-38644 and two-phase Ti-6Al-4V in the as-built condition, using scanning electron microscopy with electron backscattered diffraction imaging, optical microscopy, micro-Vickers hardness and tensile tests. Ti-6Al-4V had a fine martensitic α' structure inside columnar β grains, whereas Ti-38644 had a fully β microstructure, resulting in lower strength. The percentage elongation of Ti-38644 was thrice that of Ti-6Al-4V, showing potential for building large parts.