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PROCEEDINGS

Exploring Heat Treatment Effects on an Additively Manufactured Al6xxx Alloy

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ABSTRACT

Heat treatment is a common way for enhancing the mechanical properties of the aluminum alloys. For the alloys developed for laser powder bed fusion, changes in chemical composition, together with the non-equilibrium microstructures resulting from the ultrafast cooling rate during the process, potentially alter the effectiveness of heat treatment. This study investigates the effect of the heat treatments on a Al6xxx alloy fabricated by LPBF. The response to the same heat treatment varies depending on the initial microstructure, and similarly, different heat treatments yield distinct outcomes when applied to the same original microstructures. While there are no significant differences in the strength for the as-built samples with different ultrafine grain fractions, the strength changes after the same direct aging treatment. For as-built samples, the contribution from the grain boundaries counteracts with the contribution from solutionized atoms when the ultrafine grain fraction changes. After direct aging, the secondary Al_3X from the columnar grain region contributes to the strength significantly, which is the reason why the samples with higher fraction of the columnar grain yield at a higher strength. Among all solution + aging heat treatments, ultrahigh solution temperature causes an obvious drop in the strength, attributed to extensive grain growth. Our research enhances the understanding of the strength-ductility trade-off and unlocks potential of modified high-strength aluminum alloys.

KEYWORDS

Additive Manufacturing; aluminum alloys; heat treatment; mechanical properties

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