DYNAMIC VERSUS QUASI STATIC FRACTURE TOUGHNESS OF ADDITIVELY MANUFACTURED AlSi10Mg ALLOY BY SELECTIVE LASER MELTING TECHNIQUE

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ABSTRACT

In today's additive manufacturing sector, one of the most popular areas is selective laser melting (SLM) due to its capability of producing geometrically complex metal parts directly from CAD model in a few short steps. Many studies have been reported on static mechanical properties of SLM components; however, dynamic properties of SLM components of different materials have not been thoroughly investigated. Only few papers have been published on the dynamic mechanical behavior, especially in the crack resistance of selective laser melted AlSi10Mg alloy. In the present study, the effect of loading rate, dynamic versus quasi static, on the fracture toughness of the as-built alloy (X and Z orientations) has been investigated. The experimental results revealed the inherently anisotropic behavior for loading rates where the Z orientation exhibited lower toughness compared to the x orientation. The dynamic loading by impact, resulted in a significant decrease of the toughness values up to about 50% compared to the quasi-static loading. This mechanical response was attributed to the increase in the yield stress which alters the state stress at the crack tip from the plane-stress to some extent of the mix-mode plane stress/strain.

KEYWORDS: AlSi10Mg alloy, AM-SLM powder-bed system, fatigue initiation fracture toughness, quasi static, dynamic properties, impact loading.

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