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Direction and Location Dependency of Selective Laser Melted AlSi10Mg Specimens

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Abstract

In recent years, additive manufacturing has gained importance, especially since the full melting of the raw material in the selective laser melting process enables the fabrication of directly deployable components. However, the multiple directional dependencies involved result in an anisotropic material behavior. The raw material under investigation in this study was the precipitation-hardenable AlSi10Mg alloy, with the main focus on the positioning and inclination effects, which were studied on six characteristic orientations. In addition, the superimposed effects based on the surface condition and thermal post-treatments were taken into account. The examination contained: comprehensive tensile tests with strain gauges, detecting strains in two directions; detailed surface hardness investigations in various conditions; and micro-section investigations. Major direction dependencies were revealed and the tensile strength and the surface hardness results, coupled with annealing procedures, exhibited consistent results, explaining the encountered findings. The Young's modulus varied between 62.5 GPa to 72.9 GPa with the Poisson's ratio fluctuating between 0.29 and 0.36. Regarding the tensile strength, the UTS ranged from 314 MPa to 399 MPa with breaking elongations spanning from 3.2% to 6.5% in the non-heat-treated condition.

Keywords: Positioning, Inclination, Tensile Test, Poisson's Ratio, Hardness, Precipitation Hardening