

Laser Shock Peening on a 6056-T4 Aluminium Alloy for Airframe Applications

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Keywords: Laser Shock Peening; residual stress; synchrotron X-ray diffraction; fatigue.

Abstract:

Laser Shock Peening (LSP) is a material enhancement process used to introduce compressive residual stresses in metallic components. This investigation explored the effects of different combinations of LSP parameters, such as irradiance (GW/cm²) and laser pulse density (spots/mm²), on 3.2 mm thick AA6056-T4 samples, for integral airframe applications. The most significant effects that are introduced by LSP without a protective coating include residual stress and surface roughness, since each laser pulse vaporizes the surface layer of the target. Each of these effects was quantified, whereby residual stress analysis was performed using X-ray diffraction with synchrotron radiation. A series of fully reversed bending fatigue tests was conducted, in order to evaluate fatigue performance enhancements with the aim of identifying LSP parameter influence. Improvement in fatigue life was demonstrated, and failure of samples at the boundary of the LSP treatment was attributed to a balancing tensile residual stress.