Surface and Coatings Technology

# Evaluation of laser shock peening process parameters incorporating Almen strip deflections

Glaser, Daniel; Polese, C; Venter, AM; Marais, D; Plaisier, JR

**Abstract**
Engineering of component surfaces using Laser Shock Peening (LSP) requires optimisation of key process parameters to enhance performance through the generation of beneficial compressive residual stresses. Quantification of residual stress fields typically requires considerable experimental resources involving multiple complementary techniques to obtain reliable measurements through the depth of the target material. LSP induced plastic strains lead to the formation of residual stresses and cause deformation of thin components. This effect is routinely used in the assessment of mechanical Shot Peening (SP) where distortion coupons, called Almen strips, correlate the peening intensity to process parameters. This study explores the extension of this Almen strip concept to facilitate the quick assessment of LSP parameters for aluminium alloy 6056-T4 aeronautical structural applications. Direct measurements of the resulting LSP residual stresses have been performed using Synchrotron X-Ray Diffraction, Neutron Diffraction, and Incremental Hole Drilling, complemented by analyses of surface integrity and sub-surface modifications. It has been found that the attained near-surface compressive residual stress values and depths are strongly dependent on laser power intensity and spot coverage, whilst surface roughness and microhardness are mostly independent of the LSP parameters. Optimal parameter selection should therefore be primarily focused on the required residual stress field. A direct correlation has been observed between the magnitudes of LSP Almen distortions and the residual stresses. This qualifies extending the deflection based approach to be used as a quick, simple and effective qualitative screening technique of LSP process parameters, such as the laser power intensity saturation.