Wavelength dependent deformation in a laser peened Ti-2.5Cu alloy

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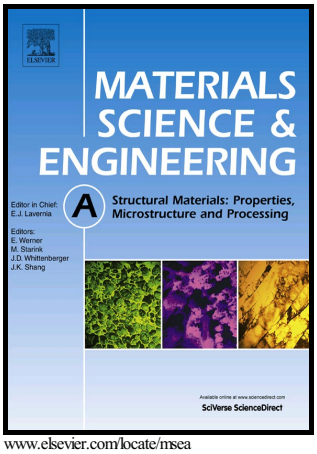

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Wavelength dependent deformation in a laser peened Ti-2.5Cu alloy

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Abstract

Laser peening without coating (LPwC) was performed on a Ti-2.5Cu alloy at wavelengths of 1064 and 532 nm and at a constant power density of approximately 7 GW cm^{-2} with overlap rates of 53, 63 and 73%. Surface softening due to thermal interaction of laser beam with material was observed till a depth of 500 μm (at 532 nm) and 200 μm (at 1064 nm), based on hardness data. This was corroborated (rather weakly) by residual stress analysis. In addition, softening due to mechanical effects (adiabatic heating) was observed in the bulk. Although there was an increase in mechanical softening with increase in overlap rates at 532 nm, it was observed, upon comparison with peened samples at 1064 nm, that the mechanical softening is a function of wavelength of radiation used for peening. It was observed that the onset of softening was earlier if the wavelength was shorter. Further, evidence of hardening in the form of twinning was found for the 1064 nm case while it was absent for the 532 nm case, for 73% overlap. The workhardened depth was more than 1000 μm, not observed in earlier studies based on residual stress analysis. The direct consequence of softening effect was found in the fatigue results. The fatigue life extended by a factor of 1.4 and 2.3 for the