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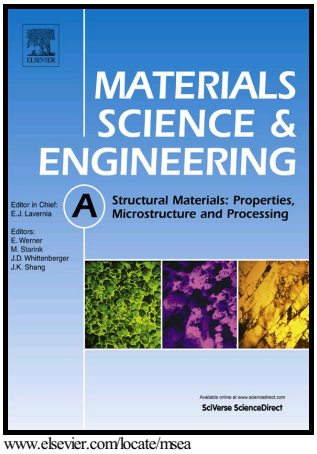

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Abstract

The present work proposes an advanced double quenching and tempering heat treatment based laser surface modification process of dual-phase spring steel. Multiple laser peening without coating process utilized the decarburized surface as the protective layer for the further cold working process. The electron backscattering diffraction analysis on crystallographic orientation of individual grains and phase map exhibits a perfect dual-phase steel. Also, the high resolution transmission electron microscopic study explains the high strain induced microstructural grain refinement features and plastic deformation behaviors. The laser peening technique taking an advantage that it induces a large and high magnitude compressive residual stress with good thermal stability. The micro and nano-hardness profile provides better surface and sub-surface mechanical properties. The controlled average surface roughness is achieved in this course of work. The stress-strain characteristics on tensile properties are analyzed through the pre-fatigued specimens. The fully reversed high cycle fatigue test indicates that the current laser peening has substantially improves the fatigue life of the specimens.

Keywords: Laser shock peening without coating (LSPwC); Double quenching and tempering (DQT); Grain refinement mechanism; Compressive residual stress (CRS); Hardness; Tensile and fatigue test