

RESIDUAL STRESS FIELDS OF AERONAUTICAL MATERIALS CAUSED BY MECHANICAL SURFACE TREATMENTS

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Abstract: The residual stress fields of aeronautical materials (300M, AerMet 100 steels, 7050-T7451, 7475-T7351 aluminum alloys, TC4, TC21 titanium alloys) induced by mechanical surface treatments (hot peening, cold expansion, laser shock peening, ultrasonic impact peening) were investigated by XRD method. The six parameters of these surface strengthening residual stress fields were proposed, these parameters are surface residual stress (σ_{srs}), maximum compressive residual stress (σ_{mcrs}), maximum tensile residual stress (σ_{mtrs}), the distance from surface to where maximum compressive residual stress is (Z_{mcrs}), the distance from surface to where maximum tensile residual stress is (Z_{mtrs}), and the depth of residual compressive stress field (Z_0). The relationships between these parameters and materials properties were discussed and the effect of residual stress by mechanical surface treatments on fatigue crack initiation and propagation behaviors was also investigated. The experimental results show that the fatigue life of surface strengthened specimens can be predicted by the resultant stress three dimensions intensity factor of external and residual stresses.

Key words: residual stresses, shot peening, cold expansion, laser shock peening, ultrasonic impact peening