

Internal stress distribution in friction stir processed AA7075 alloy reinforced by NiTi particles

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Abstract

Friction stir processing (FSP) was used to disperse NiTi pseudoplastic particles throughout the AA7075 aluminum alloy matrix. Subsequently, the study examined the fatigue crack propagation in the FSP-modified AA7075/NiTi composite compared to the FSP-modified AA7075 alloy without the reinforcing agent. The results indicated that the activation of the shape memory effect (SME) in the dispersed NiTi particles near the plastic zone of the crack tip could influence the stress field and, as a result, retard crack propagation. This phenomenon can lead to significant improvements in the fatigue fracture toughness of the FSP-modified alloy. Additionally, the internal stress distributions around the incorporated NiTi particles after FSP were evaluated and correlated with the observed enhancements in fatigue resistance. To address this, an advanced technique combining indium particle decoration through physical vapor deposition (PVD) and focused ion beam (FIB) milling was performed, followed by stress-field calculations around the dispersed NiTi particles.

Keywords: Residual stress; Crack propagation; Friction stir processing; AA7075 aluminum alloy; NiTi micro-size particles.