

Residual stresses in Al6061/DP600 welds produced by a process derived from Friction Stir Welding

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Abstract

Multi-material assemblies become attractive as they offer the synergetic effect of various materials in a single solution. In this respect, joining various metallic parts become a pivotal point to lighten the vehicles for automobile industry and thus reduce the greenhouse gas emission while maintaining their crashworthiness. The combination of Al and steels is of a particular interest due to the lightweight of Al alloys and the high strength of steels. Albeit dissimilar welding of Al/steel brings some metallurgical challenges, the new Friction Melt Bonding (FMB) technique, derived from Friction Stir Welding, is promising to join Aluminum to steel by local melting of aluminum [1]. Moreover, investigation of residual stresses in the dissimilar welded joints are important and they need to be minimized during manufacturing processes as they affect the fatigue life of the fabricated joints. Therefore, we have performed non-destructive 3D residual stress measurements for the FMB joints using neutron diffraction. The origins of residual stresses near the interface resulted from an inhomogeneous distribution of thermal cycles and the difference in coefficient of thermal expansion for both Al and steel during the cooling stage have been previously disclosed [2]. On the Al/steel interface, stresses in the steel side reveal an “M” shape distribution while, in the aluminum, stresses show a “W” shape. In this work we have investigated the residual stresses in four different welds composed of Al6061/DP600 produced with various welding conditions (2 different advancing speed and two different backing plate) [3]. The residual stress distributions from the welded structures enable to identify the influence of processing parameters on the residual stress development during the FMB process.

References

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