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The Influence of the Surface Roughness on the Microstructures and Mechanical Properties of 6061 Aluminium Alloy Using Friction Stir Welding

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Abstract

In the present study, four pairs of 6061 aluminium alloy workpieces with different surface roughness were prepared for welding. The friction stir welding (FSW) technique was used for a butt-joint configuration of a single pass. The influence of different surface roughness of the workpieces coincided with a small welding tool shoulder diameter, and the tool pin was examined. The results demonstrated that spherical nano-sized grains of the joints were produced. The mechanical properties of the joints were significantly better at the least possible workpiece surface roughness. The experimental results also indicated that the tensile strength of FSW 6061 aluminium alloy was notably affected by joining at the different workpiece surface roughness selected. However, an improvement of the Vickers microhardness in the heat affected zone (HAZ) was also observed. The microhardness in the nugget zone (NZ) for the welded joint fabricated at the lowest value of the workpiece surface roughness was higher than that of the base metal (BM). The fractural surface of the cross-section of the tensile specimens has a gradient to change from brittle fracture to ductile fracture.

Keywords: *Surface roughness; Spherical nano-size grains; Friction stir welding; Microstructures; Mechanical properties; 6061aluminium alloy*