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Temperature Evolution, Microstructure and Mechanical Properties of Heat-Treatable Aluminum Alloy Welded by Friction Stir Welding: Comparison with Tungsten Inert Gas

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Abstract: Friction Stir Welding (FSW) is a solid-state welding technique that can join material without melting the plates to be welded. In this work, we are interested to demonstrate the potentiality of FSW for joining the heat-treatable aluminum alloy 2024-T3 which is reputed as difficult to be welded by fusion techniques. Ther eafter, the FSW joint is compared with another one obtained from a conventional fusion process Tungsten Inert Gas (TIG). FSW welds are made up using an FSW tool mounted on a milling machine. Single pass welding was applied to fabricated TIG joint. The comparison between the two processes has been made on the temperature evolution, mechanical and microstructure behavior. The microstructural examination revealed that FSW weld is composed of four zones: Base metal (BM), Heat affected zone (HAZ), Thermo-mechanical affected zone (THAZ) and the nugget zone (NZ). The NZ exhibits a recrystallized equiaxed refined grains that induce better mechanical properties and good ductility compared to TIG joint where the grains have a larger size in the welded region compared with the BM due to the elevated heat input. The microhardness results show that, in FSW weld, the THAZ contains the lowest microhardness values and increase in the NZ; however, in TIG process, the lowest values are localized on the NZ.

Keywords : Friction Stir Welding, tungsten inert gaz, aluminum, microstructure