Microstructural characterization and corrosion behavior of a commercial friction stir welded AA2024-T3

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Friction Stir Welding (FSW) arises as a great development by removing rivets, fasteners and lap joints areas, consequently, decreasing the aircraft weight. However, during the welding process, the plastic deformation and heat generation at the joint and surrounding areas lead to three distinct microstructural zones, namely, nugget or stir zone (SZ), thermo-mechanically affected zone (TMAZ), heat affected zone (HAZ), besides the base metal (BM). In these zones the microstructure of the material can be profoundly modified and localized corrosion phenomena can be more easily developed, which can be enhanced by local galvanic coupling due to changes in the microstructure as grain refinement and recrystallization, changes in the grain boundaries, dissolution and precipitation of hardening precipitates and dispersóides. In the present work, a commercial friction stir welded AA2024-T3 had its microstructure characterized by Electron Backscatter Diffraction (EBSD) technique and optical microscopy (OM). The corrosion behavior was investigated by exfoliation corrosion (EXCO) test and the intergranular corrosion susceptibility according to ASTM G110-97. After all tests, the samples were observed by scanning electron microscopy (SEM). EBSD results revealed the evolution of microstructure as a result of FSW. The base metal showed elongated grains along the rolling direction with a pancake-like non-recrystallized structure. The SZ undergone dynamic recrystallization showing finer equiaxed grains as a result of a significant plastic deformation and heating during the welding process. The TMAZ of the advancing side showed recrystallized finer grains, while the TMAZ of the retreating side showed coarse grains. Finally, the HAZ of both advancing and retreating sides showed grains typically elongated caused by the thermal input. The EXCO and intergranular tests showed a more intense attack in the TMAZ of the retreating side in agreement with the corrosion morphology observed by SEM.