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WELD QUALITY IMPROVEMENT WITH HYBRID FSW TECHNOLOGY ASSISTED BY PREHEATING FOR COPPER T2/ALUMINIUM 5A06 DISSIMILAR MATERIALS

Abstract

Copper (T2) and aluminium alloy (5A06) were welded by friction stir welding (FSW). However, it is quite difficult to achieve a defect-free welding joint for welding dissimilar materials (e.g.: copper T2 / 5A06 aluminum alloy) because of the enormous difference of their thermo-physical performances. There is usually a large of void formation, cracks, and other distinct defects throughout the welds. The heat conductivity in both material sides in the weld nugget (WN) is different and the heat conductivity of copper side is 2.5 times of that of aluminium side. So much more friction heat produced by stir action in copper plate side dissipated into the nearby base metal than in aluminium side. The melting point of copper is higher than that of the aluminium toonearly 400 degree centigrades. Therefore, the metal copper and aluminium alloy close to copper side in the weld nugget (WN) zone showed a lamellar alternating structure characteristic, the copper of grains only experienced plastic deformation process in the friction stir weld, the weakest point of the joints was in this region of this copper side. In this paper, the argon arc welding was applied as a heating source to preheat the copper side to 150-200 degree centigrades in the welding direction. The distance between the welding-torch's head and the stir shoulder maintained constant. Preheating temperature can make up the lost heat, improve the temperature of copper plate before the FSW process, achieve the refining grains, and then obtain a high quality welding joint. We concentrated on hybrid heat-source equipments design and procedure optimization in our studies. The microstructure, mechanical properties and phase constituents of FSW joints were studied through mechanical test, metallographic analysis and X-ray diffraction. The results indicated that the hybrid FSW technology with preheating for copper T2/aluminium 5A06 dissimilar materials can not only improve the welding efficiency, but also obtain the high quality welding joint. This special welding technology could solve the welding problems of Al-Cu dissimilar materials and had a good potential for application in aerospace manufacturing.