Abstract

A new spot welding process, derived from Friction Stir Spot Welding (FSSW) process, is proposed in this research. It is called Back Filler Friction Spot Welding process (BFFSW).

In the new process, the keyhole which is accompanying FSSW process, is eliminated without any additional process.

BFFSW process was used to weld similar sheets of aluminum alloys AA2024-T3 and AA6061-T6, of 1.0 and 0.5 mm thick, also 1.0 and 0.6 mm thick of AA1050 aluminum alloy, in addition to weld dissimilar sheets of pure commercial copper and AA1050 aluminum alloy of 1.0 mm thick.

Four rotational speeds for the welding tool , (900, 1120, 1400, and 1800 rpm), and four feed rates (16, 20, 25, and 31.5 mm/min) were used, in addition to study the effect of pin descending depth of the welding tool into the upper surface of the upper sheet, three pin descending depths (0.7, 0.8, and 0.9 mm and 0.3, 0.4, and 0.5 mm) for 1.0 mm and 0.5 mm thick sheets, respectively.

To evaluate the new process, many tests on spot welded specimens were achieved, tensile shear and cross bar tests were accomplished. The results showed that the maximum tensile shear load of AA2024 aluminum alloy welded specimens of 1.0 mm thick was 3500 N and 1155 N for cross bar test, while for 0.5 mm thick welded specimens the load was 2100 N and 720 N for tensile shear and cross bar tests, respectively. The welded specimens of AA6061 of 1 mm thick gave 3670 N as max tensile shear load and 1130 N as cross bar load, for similar AA1050 aluminum alloy with 1.0 mm thick, the results were 2060 and 1130 N , and for 0.6 mm thick, the results were 1160 and 400 N , as maximum loads for tensile shear and cross bar tests, respectively. For pure commercial copper welded

to AA1050, 1.0 mm thick welded specimens, the max loads were , 2460 and 1150 N for tensile shear and cross bar tests, respectively.

Tensile fatigue test of AA2024-T3 and AA6061-T6 aluminum alloy sheets 1.0 mm thick , welded at the best conditions , sowed that the maximum failure loads of AA2024-T3 welded specimens were always higher than that of AA6061-T6 with a percentage range of (30-64 %).

The axial load and tool torque during welding process were measured experimentally. The results showed that the axial load is directly proportional to the strength of the welded specimens, while the tool torque is inversely proportional to the strength of the welded specimens.

Microstructural examination showed that the back filler disc interacts with the lower sheet in a good manner by the hooks spread along the contact line between them.

A 3-Dimention nonlinear model was built by ANSYS-11 to see the temperature distribution during the welding process. The results showed a good convergence with the experimental results, the temperatures measured experimentally were always higher than that obtained from ANSYS model, except in case of the temperature at the center of the spot , the ANSYS one was larger .