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Refilled friction stir spot welding of aluminum alloy to galvanized steel

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ABSTRACT

Joining of aluminum alloy to galvanized steel sheets was investigated with refilled friction stir spot welding. For the lap joint between 1.0-mm thick Novelist AC 170 PX aluminum alloy and 1.2-mm thick ST06 Z galvanized steel sheets, the maximum tensile/shear fracture load is 3044 N with cross-tension fracture load of 296 N. For that between 1.5-mm thick Aleris Superlite 200 ST aluminum alloy and 1.2-mm thick ST06 Z galvanized steel sheets, the maximum tensile/shear fracture load reaches 4500 N, and the maximum cross-tension fracture load is 359 N. All samples failed through the Al/steel interface during tensile/shear and cross-tension tests. The microstructure, composition, fractography, and fracture mode of Al/steel joints were analyzed with electron probe microanalysis, scanning electron microscope, and X-ray diffraction. Zinc and oxygen rich zones were observed in the interface on aluminum side, and ZnO phase was detected on the fractured surface of both aluminum alloy and steel sides. The samples during tensile/shear test failed mainly through shear brittle fracture with features of cleavage and intergranular fracture feature. The weld can be distinguished as sleeve stirred zone and pin refilled zone due to the distribution of zinc coating.

KEYWORDS: refilled friction stir spot welding, aluminum/steel dissimilar materials, mechanical property