ABSTRACT

Friction stir welding (FSW) has garnered significant attention as a robust technique for joining aluminum alloys due to its advantages in producing high-quality welds with minimal distortion and defect formation. This study investigates the FSW process applied to both coated and uncoated 5052 aluminum alloys, aiming to discern the influence of coating presence on the welding characteristics and resultant weld properties.

Coated aluminum alloys, exemplified by Alclad coatings, featuring a thin layer of pure aluminum bonded to the alloy core, are juxtaposed against their uncoated counterparts. Experimental trials encompass a comprehensive range of FSW parameters, including rotational speed, traverse speed, plunge depth, and tool geometry, tailored to optimize the welding process for each material variant.

Microstructural analysis, employing techniques such as optical microscopy and scanning electron microscopy, elucidates the weld zone, heat-affected zone, and base metal regions, capturing microstructural alterations such as grain refinement, intermetallic formation, and coating integrity. Additionally, mechanical assessments via tensile, hardness, and impact testing are conducted to evaluate the welds' mechanical properties and performance.

This investigation furnishes valuable insights into the disparate welding behaviors and characteristics of coated and uncoated 5052 aluminum alloys when subjected to FSW. The discernment of these distinctions holds paramount importance in fine-tuning welding parameters and ensuring the fidelity and durability of welded joints across diverse industrial sectors, including aerospace, automotive, and marine engineering.

Keywords: Friction stir welding, Aluminum alloys, Coated alloys, Uncoated alloys, 5052 alloy, Microstructure, Mechanical properties.