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Simulation of weld morphology during friction stir welding of aluminum- stainless steel joint

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Abstract

In order to predict dissimilar materials' flow behavior during friction stir welding, a morphological simulation of the weldment was performed using Level Set (LS) method. Thermal and computational fluid dynamics (CFD) simulations were conducted to calculate the temperature distribution and material flow velocity during the welding process. Level set model was created to predict the weld morphology based on CFD results. Weld morphologies in different tool rotational speeds, offsets position and height levels of the specimen were simulated. In order to validate the simulations, temperature measurements, optical microscopy (OM) of the weldment and scanning electron microscopy (SEM) of the stirred zone (SZ) were carried out. It was seen that the main cause of defects in the weld zone were steel particles detached in aluminum matrix. The simulation results revealed that increasing rotational speed and offset through the steel side could generate more steel particles. Also, the particles were more in the top height level of the weld section than in the middle and bottom levels.

Keywords: Dissimilar joint, Friction stir welding, Morphology simulation, Level set method.