Contribution ID : **54** Type : **Talk**

Additive Friction Stir Deposition (AFSD) for High-Strength Aluminium Alloys

Tuesday, 5 November 2024 09:50 (20)

Additive Friction Stir Deposition (AFSD) is a rapidly emerging solid-state additive manufacturing (AM) process characterised by high deposition rate. As a non-fusion AM technique, AFSD avoids defects related to melting, such as solidification cracking, allowing for the processing of high-strength aluminium alloys with solidification cracking susceptibility. Additionally, AFSD generates lower residual stress compared to other AM processes. The severe plastic deformation inherent in the process promotes metallurgical bonding between dissimilar aluminium alloys and facilitates the breakup of brittle intermetallics, making AFSD suited for utilising recycled feedstock material. However, the thermal cycling during layer deposition affects the precipitation-strengthening mechanism in high-strength aluminium alloys, leading to hardness gradient in as-manufactured structure.

This study investigates the microstructure and defect formation in a two-step AFSD-manufactured Al6061 structure with deposit heights of 18.5 mm and 10.5 mm. Residual stress analysis is performed on a three-step Al6061 structure with deposit heights of 9.5 mm, 6.5 mm, and 3.5 mm. Additionally, we present preliminary results on the microstructure, material distribution, hardness, and residual stress of a 4 mm-high recycled aluminium structure manufactured via AFSD using alternating Al6061/Al7075 feedstock.

The microstructure is characterised using optical microscopy, scanning electron microscopy, energy-dispersive X-ray spectroscopy, and electron backscatter diffraction, while material flow and defect analysis is performed via X-ray computed tomography. Hardness mapping is employed to assess the mechanical properties, and residual stress distribution is measured non-destructively using neutron diffraction. The findings from this research provide critical insights for the large-scale industrial application of AFSD.

Topics

Manufacturing, Engineering and Industry

Primary author(s) : YAKUBOV, Vladislav (University of Sydney); YASA, Evren (University of Sheffield, Advanced Manufacturing Research Centre (AMRC)); HUGHES, James (University of Sheffield, Advanced Manufacturing Research Centre (AMRC)); KARPENKO, Michail (Heavy Engineering Research Association); PARADOWSKA, Anna (Australian Nuclear Science and Technology Organisation)

Presenter(s) : YAKUBOV, Vladislav (University of Sydney)

Session Classification : Talks