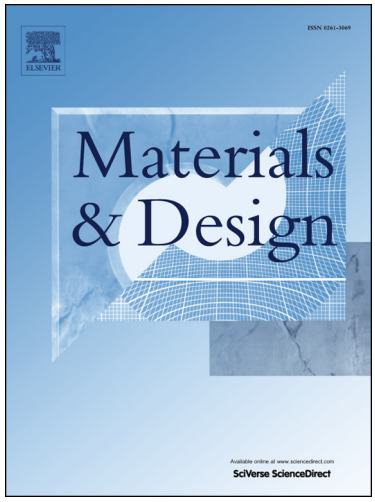

Effect of tool geometry, rotation and travel speeds on properties of lap joint friction stir welding of dissimilar magnesium/aluminum

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Abstract

Lap joint friction stir welding (FSW) between dissimilar AZ31B and Al 6061 alloys sheets was conducted using various welding parameters including tool geometry, rotation and travel speeds. Tapered threaded pin and tapered pin tools were applied to fabricate FSW joints, using different rotation and travel speeds. Metallurgical investigations including X-ray diffraction pattern (XRD), optical microscopy images (OM), scanning electron microscopy equipped with an energy-dispersive X-ray spectroscopy (SEM-EDS) and electron probe microanalysis (EPMA) were used to characterize joints microstructures made with different welding parameters. Intermetallic phases were detected in the weld zone (WZ). Various microstructures were observed in the stir zone which can be attributed to using different travel and rotation speeds. Mechanical evaluation including lap shear fracture load test and microhardness measurements indicated that by simultaneously increasing the tool rotation and travel speeds, the joint tensile strength and ductility reached a maximum value. Microhardness studies and extracted results from stress-strain curves indicated that mechanical properties were affected by FSW process. Furthermore, phase analyses by XRD indicated the presence of intermetallic compounds in the weld zone. Finally, in the Al/Mg dissimilar weld, fractography studies showed that intermetallic compounds formation in the weld zone had an influence on the failure mode.

Keywords: Lap joint friction stir welding; AZ31B Mg alloy; 6061 Al alloy; Metallurgical investigations; Mechanical characterizations; Fractography.

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