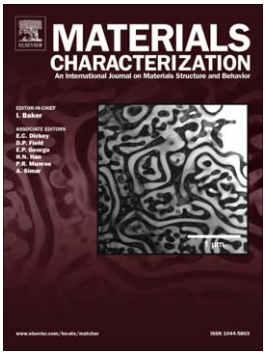

Grain Structure, Texture and Mechanical Property Evolution of Automotive Aluminium Sheet during High Power Ultrasonic Welding

Farid Haddadi, Dimitrios Tsivoulas

PII: S1044-5803(16)30170-X
DOI: doi: 10.1016/j.matchar.2016.06.004
Reference: MTL 8277

To appear in: *Materials Characterization*

Received date: 25 January 2016
Revised date: 3 May 2016
Accepted date: 6 June 2016

Please cite this article as: Haddadi Farid, Tsivoulas Dimitrios, Grain Structure, Texture and Mechanical Property Evolution of Automotive Aluminium Sheet during High Power Ultrasonic Welding, *Materials Characterization* (2016), doi: 10.1016/j.matchar.2016.06.004

Grain Structure, Texture and Mechanical Property Evolution of Automotive Aluminium Sheet during High Power Ultrasonic Welding

Farid Haddadi[1,2], Dimitrios Tsivoulas[2,3]

fhaddad@g.clemson.edu, dim.tsivoulas@gmail.com

1. Clemson University – International Center for Automotive Research (CU-ICAR), #347, 4 Research Drive, Greenville, SC, US 29607
2. School of Materials, The University of Manchester, Oxford Road, Manchester, M13 9PL, UK
3. Clean Energy/Nuclear Services, Amec Foster Wheeler, 601 Faraday Street, Birchwood Park, Warrington, WA3 6GN, UK

Abstract

High power ultrasonic spot welding (HPUSW) is a joining technique which is performed within less than a second and provides a more energy-efficient alternative to friction stir spot welding (FSSW), which is considered a longer cycle manufacturing process for joining automotive alloys. To date, only a few reports exist on the deformation mechanisms that take place during high power ultrasonic spot welding. In this work, dynamic recrystallization and grain growth were examined using electron backscatter diffraction (EBSD). HPUSW causes extensive deformation within the weld zone where the temperature increases to 440 °C. An ultra-fine grain structure was observed in a thin band of flat weld interface within a short welding time of 0.10 sec. With increasing welding time the interface was displaced and 'folds' or 'crests' appeared together with shear bands. The weld interface progressively changed from flat to sinusoidal and eventually to a convoluted wave-like pattern when the tool fully penetrated the workpiece, having a wavelength of ~1 mm after 0.40 sec. Finally, the microstructure and texture varied significantly depending on the location within the weld. Although the texture near the weld interface was relatively weak, a shift was observed with increasing welding time from an initially Cube-dominated texture to one where the typical β-fibre Brass component prevailed.

Keywords: High power ultrasonic spot welding; Aluminium 6111-T4; Dynamic recrystallization; Grain growth; EBSD; Texture.