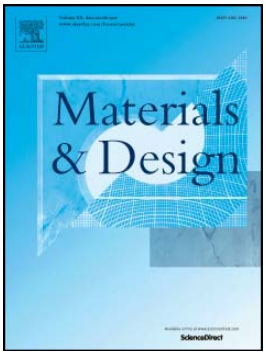

Microstructure characterization and properties of carbon steel to stainless steel dissimilar metals joint made by friction welding

Hong Ma, Guoliang Qin, Peihao Geng, Fei Li, Banglong Fu, Xiangmeng Meng

PII: S0264-1275(15)30137-4
DOI: doi: 10.1016/j.matdes.2015.07.068
Reference: JMADE 296

To appear in:

Received date: 30 January 2015
Revised date: 10 July 2015
Accepted date: 12 July 2015

Please cite this article as: Hong Ma, Guoliang Qin, Peihao Geng, Fei Li, Banglong Fu, Xiangmeng Meng, Microstructure characterization and properties of carbon steel to stainless steel dissimilar metals joint made by friction welding, (2015), doi: 10.1016/j.matdes.2015.07.068

Microstructure characterization and properties of carbon steel to stainless steel dissimilar metals joint made by friction welding

Hong Ma, Guoliang Qin*, Peihao Geng, Fei Li, Banglong Fu, Xiangmeng Meng

Key Laboratory for Liquid-Solid Structural Evolution and Processing of Materials Ministry of Education, Shandong University, Jinan 250061, PR China

ABSTRACT： Dissimilar metals of 1045 carbon steel and 304 stainless steel are joined successfully by friction welding. The microstructure variation and mechanical properties are studied in detail. The weld interface can be clearly identified in central zone, while the two metals interlock with each other by the mechanical mixing in peripheral zone. On carbon steel side, a thin proeutectoid ferrite layer forms along weld interface. On stainless steel side, austenite grains are refined to submicron scale. The δ-ferrite existing in stainless steel decreases from base metal to weld interface and disappears near the weld interface. Severe plastic deformation plays a predominant role in rapid dissolution of δ-ferrite compared with the high temperature. Carbide layer consisting of CrC and $Cr_{23}C_6$ forms at weld interface because of element diffusion. Metastable phase CrC is retained at room temperature due to the highly non-equilibrium process and high cooling rate in friction welding. The fracture appearance shows dimple fracture mode in central zone and quasi-cleavage fracture mode in peripheral zone. Further analysis indicates that welding parameters govern tensile properties of the joint through influencing the thickness of carbide layer at weld interface and heterogeneous microstructure in thermo-mechanically affected zone on carbon steel side.

Keywords: Friction welding; Dissimilar metals welding; Microstructure; Mechanical properties

* Corresponding author. Tel.: +86 13505400905.
E-mail address: glqin@sdu.edu.cn (G.L. Qin)