

Author's Accepted Manuscript

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PII: S0921-5093(17)31519-8
DOI: <http://dx.doi.org/10.1016/j.msea.2017.11.058>
Reference: MSA35773

To appear in: *Materials Science & Engineering A*

Received date: 16 October 2017
Revised date: 14 November 2017
Accepted date: 15 November 2017

Cite this article as: Z.G. Zhu, Y.F. Sun, F.L. Ng, M.H. Goh, P.K. Liaw, H. Fujii, Q.B. Nguyen, Y. Xu, C.H. Shek, S.M.L. Nai and J. Wei, Friction-stir welding of a ductile high entropy alloy: microstructural evolution and weld strength *Materials Science & Engineering A* <http://dx.doi.org/10.1016/j.msea.2017.11.058>

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Friction-stir welding of a ductile high entropy alloy: microstructural evolution and weld strength

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Abstract

High entropy alloys (HEAs) are a novel subset of metallic systems with complex compositions usually yielding simple phase formation. To verify their potential engineering applications, a novel $\text{Co}_{16}\text{Fe}_{28}\text{Ni}_{28}\text{Cr}_{28}$ HEA with a low content of expensive Co was developed and its welding characteristics through friction-stir welding (FSW) were investigated. The HEA shows a stable face-centered-cubic (FCC) structure with an excellent ductility of about 70%. The microstructural evolution during FSW was dominated by discontinuous recrystallization through grain bulging and the $\text{B}/\bar{\text{B}} \{112\}\langle 110\rangle$ shear texture formed in the stir zone (SZ). A white band (WB) containing W-rich and Cr-rich phases was detected in the SZ. The WB exhibited refined grains compared with the normal SZ, which may be associated with the particle-stimulated nucleation (PSN). The present understanding of the microstructural evolution during FSW of HEAs may help tailor the weld properties to pave the way for their engineering applications.

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