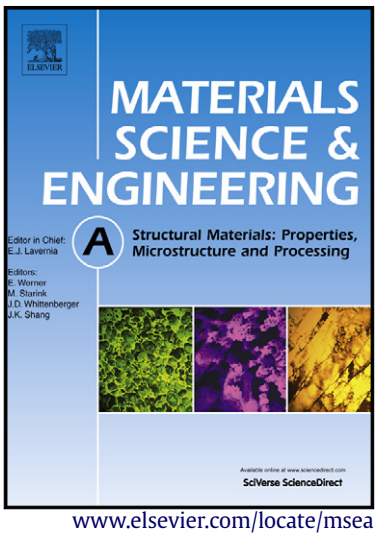

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S. Sahraeinejad, H. Izadi, M. Haghshenas, A.P. Gerlich

PII: S0921-5093(14)01577-9
DOI: http://dx.doi.org/10.1016/j.msea.2014.12.077
Reference: MSA31894

To appear in: *Materials Science & Engineering A*

Received date: 6 November 2014
Revised date: 18 December 2014
Accepted date: 19 December 2014

Cite this article as: S. Sahraeinejad, H. Izadi, M. Haghshenas, A.P. Gerlich, Fabrication of metal matrix composites by friction stir processing with different Particles and processing parameters, *Materials Science & Engineering A*, http://dx.doi.org/10.1016/j.msea.2014.12.077

Fabrication of Metal Matrix Composites by Friction Stir Processing with Different Particles and Processing Parameters

S. Sahraeinejad [a], H. Izadi [b], M. Haghshenas [a, *], A.P. Gerlich [a]

[a] *Department of Mechanical and Mechatronics Engineering, University of Waterloo, Waterloo, Canada N2L 3G1*

[b] *Department of Chemical and Materials Engineering, University of Alberta, Edmonton, Alberta, Canada T6G 2V4*

Abstract

Friction stir processing has been employed to produce metal matrix composites by incorporating reinforcement particles in an Al 5059 matrix. The fabrication method involved repeated friction stir passes on a groove which contained powder reinforcements, with different processing parameters and tool geometries used for each pass. Various particles with sizes from 130 nm to 4.3 μm, and different process parameters were examined to obtain a uniform distribution of particles within the stir zone. Mechanical properties (*i.e.* tensile and microhardness) of the Al 5059 matrix MMCs reinforced with Al_2O_3, SiC, and B_4C with particle sizes of 130, 250, and 35 nm respectively were compared. Tensile tests showed 11, 20, and 38 percent increases in yield strength compared to the matrix alloy for composites containing nano-scale Al_2O_3, SiC, and B_4C, respectively. When 4.3 micron Al_2O_3 particles were employed, higher volume fractions could be achieved which resulted in an 32% increase in yield strength compared to the base metal. The average microhardness value within the stir zone increased from 85 HV in the base material to a maximum of 170 HV in the B_4C-reinforced composite. Nano-scale particles seem to be more effective to increase hardness by increasing the particle fraction in the produced composites.

1. Introduction

Friction stir processing (FSP) is a solid state material processing technique based on the principles of friction stir welding development by The Welding Institute (TWI) in 1991 [1].

* Corresponding author
Email: mhaghshe@uwaterloo.ca
Phone: +1 (519) 777 8978