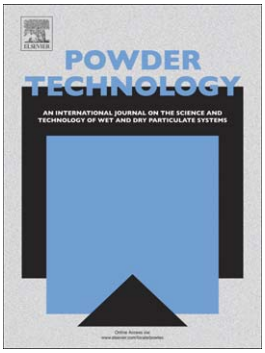

Microstructure metrics for quantitative assessment of particle size and dispersion: Application to metal-matrix composites

Mohammad Jahedi, Ehsan Ardjmand, Marko Knezevic

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Microstructure metrics for quantitative assessment of particle size and dispersion: Application to metal-matrix composites

Mohammad Jahedi [a,*], Ehsan Ardjmand [b], Marko Knezevic [a]

[a] Department of Mechanical Engineering, University of New Hampshire, Durham, NH 03824, USA.

[b] College of Business, Department of Management, Frostburg State University, Frostburg, MD 21532, USA.

Abstract

Homogeneous dispersion of reinforcement particles within a matrix is of paramount importance for achieving high quality metal-matrix composite (MMC) materials. This paper develops a protocol for quantitative evaluation of particle size and dispersion in MMC microstructures. The protocol is based on statistical analysis of features in micrographs and embedding the information into a suitably defined microstructure homogeneity metric (*H*-metric) and a particle size distribution metric. Every micrograph undergoes the *K*-means clustering algorithm for accurate separation of phases before it is used in calculation of the metrics. Finally, the protocol relies on analysis of variance to verify the meaningfulness of results. The protocol is applied to study homogeneity and particle size distribution in MMCs consisting of Cu-matrix with 20vol.%-SiC The composites were processed using high pressure torsion and double torsion to a different number of torsional turns. During processing, particles fragment and form clusters of fragments. As straining continues, the clusters of fragments disperse in the matrix. A decrease and then increase of the *H*-metric demonstrates that the metric can pick up these processes occurring in the microstructure. The analysis reveals a strong correlation between the particle dispersion homogeneity and particle size distribution. The protocol developed herein can facilitate the design of MMCs with superior properties through engineering optimal homogeneity and particle size distributions in function of process variables.

* Corresponding author at: Department of Mechanical Engineering, University of New Hampshire, 33 Academic Way, Kingsbury Hall, W322, Durham, NH 03824, USA.
E-mail address: mohammad.jahedi@unh.edu (M. Jahedi).