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PREDICTION OF Al-B4C NANOCOMPOSITE POWDER PARTICLE SIZE BY NEURAL NETWORK MODELING

M. Khakbiz[1], F. Akhlaghi[2,*], A. R. Bazaz[3]

[1,2]School of Metallurgy and Materials Engineering, Center of Excellence for High Performance Materials, University of Tehran, Tehran, Iran

3Department of Materials Science and Engineering, Faculty of Engineering, Ferdowsi University of Mashhad, Mashhad, Iran.

In this paper, Al-B_4C nanostructured powder was synthesized by high energy ball milling. Different sized Al and B_4C powders with different proportion were milled in a high energy ball mill from 2h up to 16h. The size characteristics of the particles were determined by laser particle size analyzer (LPS) and scanning electron microscopy (SEM) and the required data for training the networks were collected from the experimental results. Two three-layer feed-forward artificial neural networks were developed for modeling the effects of mechanical alloying parameters including aluminum particle size, B_4C size and its content on powder particle size characteristics. The average particle size (D_{50}) and the extension of size distribution (D_{90}-D_{10}) were considered as target values for modeling. The developed networks were trained using error back propagation method. In training the networks 70% of experimental data were used and the rest of data were utilized for verification of the networks performance.

Figure 1, 2 show the effect of milling time on the average particle size (D_{50}) and the extension of size distribution (D90-D10) for Al-10wt%B_4C nanocomposite powder. During the first 4h of milling the D50 and D90-D10 increased while by increasing milling time up to 16h, D_{90}-D_{10} and D_{50} decreased. Increasing D_{50} and broader particle size distribution is due to the predominance of particle deformation during the first 4h of milling while decreasing D_{50} and the closer distribution after 4h milling is because welding occurs especially on the smaller particles and fracture on the higher particles.

By comparison experimental and modeling results, it was found that neural networks yield good results and acceptable prediction between the responses of the networks and the experimental data with high correlation coefficients (Fig 1, 2). Results showed that the effect of processing variables such as milling time, B4C size and its content on D50 and D90-D10 of Al-B4C nanocomposte powder could be successfully predicted. This modeling procedure can be used for optimization of the mechanical alloying process for synthesis of nanostructured metal matrix nanocomposites.

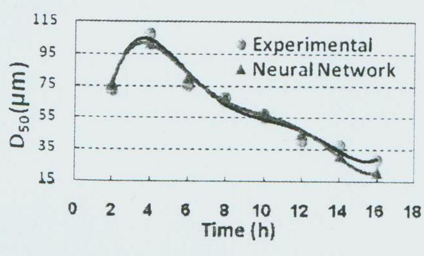

Fig.1 Powder Particle Size (D_{50}) for Al-B_4C Nanocomposite

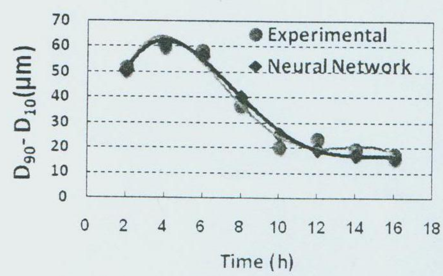

Fig.2 Extension of Size Distribution (D_{90}-D_{10}) for Al-B_4C Nanocomposite