Modelling and optimization of hardness behaviour of sintered Al/SiC composites using RSM and ANN: a comparative study

ABSTRACT

In present work, Aluminium matrix composites reinforced with x wt.% SiC (x = 5, 7.5 and 10) microparticles were synthesised by powder metallurgy route. The microhardness (VHN) of the Al/SiC composites were investigated using Response Surface Methodology (RSM) and artificial neural network (ANN) approach. Scanning electron microscopy (SEM), Energy-dispersive X-ray spectroscopy (EDS), Elemental mapping and Optical microscopy were done for the microstructural investigations. The X-ray diffraction (XRD) analysis was done for received powders and composites samples for phase recognition and existence of reinforcement particles (SiC) in the synthesised sintered composites. The design of experiments based on RSM was utilised following the central composite design method. Empirical models have been developed by considering variance analysis (ANOVA), to establish relationships among the control factors and the response variables. A feed-forward back-propagation neural network (FF-BPNN) was used to determine the qualitative characteristics of the process, and the accuracy of the BPNN system was attributed with mathematical models based on RSM model. The ANN model predicted surface hardness values are near the experimental findings. It is established that the developed models can be used to predict the hardness of the surface within the investigation range. The composite with reinforcement 7.5% revealed higher sintered density and Vickers microhardness due to the uniform distribution of filler particles in the Al matrix featuring no pores. The results indicate overall higher accuracy in the ANN method than RSM model.

Keyword: Al–SiC composites; Powder metallurgy; Vickers microhardness; Response surface methodology; Artificial neural networks