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Modeling the constitutive relationship of Al–0.62Mg–0.73Si alloy based on artificial neural network

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ABSTRACT

In the present work, the isothermal compression tests of Al–0.62Mg–0.73Si aluminum alloy were carried out by using the Gleeble-1500D thermo-simulation machine. The samples were tested in the temperature range of 410–510°C and strain rate range of 0.001–1 s^{-1}. Based on the obtained stress–strain curves, the hot deformation behavior was presented. The constitutive relationship of Al–0.62Mg–0.73Si aluminum alloy was developed using an Arrhenius-type constitutive model with experimental values at the peak stress. Moreover, an artificial neural network model was employed, and a comparison between the two established models was discussed with statistical parameters such as correlation coefficient and absolute value of relative error. It was found that deformation temperature and strain rate have significant influence on the flow characteristics, and the flow stress increases with the increasing strain rate and the decreasing temperature. Moreover, the proposed models exhibited excellent prediction capability of flow stresses for the present alloy during hot deformation. Compared with the traditional Arrhenius-type model, the neural Network model is found to be more accurate when presenting the isothermal compressing deformation behaviors at elevated temperatures for Al–0.62Mg–0.73Si alloy.

KEYWORDS: aluminum alloy, artificial neural network, deformation behavior