Estimation of the effective boron diffusion coefficient in Fe2B and modeling of the growth kinetics of boride layers by the artificial neural network approach and the regression model

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Abstract

In this current work, the boron diffusion coefficient in Fe2B was firstly evaluated using a diffusion model. It considers the effect of the incubation times required to form the Fe2B layers by the powder-pack boriding on a gray cast iron substrate**.** This model solves the mass balance equation at the (Fe2B/ substrate) interface under certain assumptions. Afterwards, the effective boron diffusion coefficient in Fe2B was evaluated through an application of a simple equation. As a result, the evaluated value of activation energy of boron in the presence of chemical stresses was found to be equal to 165.06 kJ mol-1. It is also shown that the computed values of boron effective diffusivity in Fe2B considerably change with temperature. The values of boron effective diffusion coefficients in Fe2B are found to be decreased with an increase of the upper boron content in Fe2B within the composition range of (- mol m-3), for a given boriding temperature. In addition, the artificial neural network model and the regression model were suggested to predict the growth kinetics of Fe2B layers. A good agreement was obtained between the simulated results and the experimental data in the temperature range of 1173-1273 K.

Keywords: Boriding, Chemical stresses, Kinetics, Fick's law, effective diffusion coefficient, ANN model, Regression model

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