ABSTRACT

A finite-difference numerical model is developed to describe the heat transfer and the austenite–pearlite transformation in a 0.8 *wt*% plain carbon steel. The model is validated by matching the complete cooling curve with experimental data. In the macro-microscopic model developed for the austenite–pearlite transformation, though the nucleation rate is not modelled, the growth rate is modelled using a fixed number of nucleants. The model is found to represent the cooling curve quite well in terms of undercooling, recalescence and eutectoid hold time.

The macro-microscopic model is used to simulate TTT diagrams of Fe–0.8 *wt*% C steel. The simulated TTT diagrams are compared with an available experimental TTT diagram to obtain insight into the mechanism of pearlite growth. The same model is then used to predict the effect of changing various transformation parameters, such as number of nuclei, growth rate, grain impingement, *etc.*, on TTT diagrams. In particular, the combined effect of changing both the diffusivity of carbon and the eutectoid temperature on growth rate is found to be in agreement with the observed effect of Cr on the experimental TTT diagram for Fe–0.8 *wt*% C eutectoid steel. Finally, with the success of the previous steps, the model is successfully applied to characterize the diffusivity of carbon in steel in the presence of Cr, by matching the simulated TTT diagram with an experimental TTT diagram of a Fe–0.8 *wt*% C–1.41 *wt*% Cr steel.

Key words: *Numerical model, Macro-microscopic model, Heat transfer, Transformation kinetics, Nucleation and growth, Zener–Hillert model, Austenite, Pearlite, Plain-carbon steel, Cr-containing steel.*