Abstract

Near eutectoid steels possess high strength along with ductility and are widely used in various structural sectors such as rails, bridge cables, piano strings, beads, etc. In the first part of thesis, effect of Mn concentration in near eutectoid steel after isothermal transformation to pearlite was studied on the kinetic, microstructure and strain hardening behaviour. An analysis of growth rate during isothermal transformation indicates that pearlite growth rate is at its maximum rate when the true (i.e., minimum value) interlamellar spacing is 1.5 to 1.58 times its critical spacing. Thus, the experimental interlamellar spacing can be determined theoretically. The mean random interlamellar spacing decreases with increase in the austenitization temperature for both isothermal and continuous cooling treatments. The dilatometric experimental and DICTRA simulation results were compared. The similar behaviour has observed for the kinetics of pearlite transformation in both experimental and simulated results obtained during continuous cooling. In Mn containing steels, the strain hardening exponent and interlamellar spacing increases with increase in Mn concentration. The refinement of pearlite and a significant increase in strain hardening is observed.

In the second part of the work, near eutectoid steel having the composition in the hyper eutectoid range was studied where the evolution of texture and microstructure with varying degree of drawing strain of cold drawn wire rod was of primary focus. In the initial stages of deformation (up to true strain of 0.5), $\{110\} < 1\bar{1}1 >$ system is more active compared with to $\{112\} < 11\bar{1} >$. However, at higher strains, there is a crossover and $\{112\} < 11\bar{1} >$ slip system becomes more dominating compared with $\{110\} < 1\bar{1}1 >$. The effect of the austenitization temperature on transformed pearlite microstructure is explained in case of both undeformed and highest deformed sample. The different orientation relationship criteria provide a good account of the experimental behaviour in terms of capturing both the weakening of texture and the characteristic <110> fiber texture in transformed ferrite. No further refinement in mean random interlamellar spacing takes place in transformed pearlite above the drawing strain of 0.46.

Keywords: Near eutectoid steel; microstructure; Interlamellar spacing; DICTRA simulation; Strain hardening exponent; Cold drawn pearlitic wires; texture.