# Abstract

High strength Dual Phase (DP) and Press Hardenable Steels (PHS) have been selected for this work. The substrate surfaces were modified using prior coating of copper and nickel. The pre-coated steels were galvanised and the microstructural features of the galvanised coating were studied under different processing conditions similar to industrial conditions. The nucleation and growth kinetics of prior copper coated DP steels have been studied. The mathematical predictions and experimental validations show that the nucleation and growth rate of iron-zinc ζ phase is decreased with increase of copper concentration. The phase morphology was found to have altered as compared to conventional galvanised coatings. The prior copper coating exhibited barrier effect to manganese diffusion when subjected to high temperature annealing process. The simulations and experimental results show that manganese oxide precipitates at the steel-copper interface. This effectively suppresses the external oxidation of manganese at the steel surface. The evolution of microstructure of prior copper coated annealed steel was studied further. The interface was continuous and the coated material was free of bare spots.  Copper was found to be rejected from the interface and segregated at the overlay zinc.

The effect of prior coating of nickel on phase formation during batch galvanising was further studied. The thickness of initial nickel coating is important to determine the phases in the final coating. The critical nickel coating thickness is found to be 4 μm for a galvanising time of 10 s for transition from iron-zinc to nickel-zinc phases. The nickel-zinc phases are identified to be δ and γ phase and the β1 phase was absent. The growth kinetics is calculated and compared with experimental data.

The galvanised coating with nickel-zinc phases was subjected to heat treatment to study the phase formation during austenitising process of boron added press hardenable steels. The nickel-zinc coating having multi-layered structure has different melting points for different phases. The coating undergoes simultaneous phase transformations like melting of zinc-rich low melting phases, diffusion of iron from substrate to the melt leading to supersaturation of iron and precipitation of iron-rich solid phases. The initial phase layer thicknesses determine the final fraction of iron and zinc-rich phases. The coating, when subjected to hot deformation tests, showed occasional presence of microcrack depending upon the final phase fraction of zinc-rich phases.