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Influence of different C, Ti, B, Mn, and Al content on hot ductility behavior of two micro-alloyed steel at different strain rates

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The ductility behavior of continuously cast steel is a key factor influencing strand quality and crack susceptibility. Therefore, investigating the parameters affecting ductility is of great importance for enhancing the productivity of the method by producing defect-free products. This study investigates the differences in ductility behavior between two micro-alloyed steels subjected to hot tensile testing at strain rates of 10^{-3} s^{-1} and 10^{-2} s^{-1} at 700 ℃, 750 ℃, and 800 ℃. The first material is low-carbon micro-alloyed steel, and the second contains a higher C, Ti, and B, along with lower Mn and Al content. Both steels were tested after in-situ melting using an induction heating system in a vacuum chamber, followed by hot tensile testing until the fracture. The results indicate that the steel with higher B and Ti content exhibits better ductility at both strain rates. This was attributed to the precipitation behavior and the austenite-ferrite phase transformation. These effects are associated with the preferential formation of coarse TiN rather than AlN and BN. Additionally, the segregation of free B at grain boundaries, which did not form BN, delayed ferrite formation, thereby retarding the crack susceptibility caused by thin ferrite films at austenite grain boundaries. An initial microstructure analysis was conducted to observe the influence of temperature and strain rate on both steels. Furthermore, the precipitation kinetics of both steels were evaluated using MatCalc software, which provided predictions for the expected precipitates. The simulation results are compared with the experimental findings to enhance understanding of the underlying mechanisms.

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