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Effect of molybdenum on the precipitation in ferritic niobium-containing steels produced by strip casting

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Molybdenum (Mo) is often alloyed into the steels containing niobium (Nb), in order to enhance the formation of harder microstructures, such as bainite and acicular ferrite, and denser and finer precipitates. However, the effect of Mo on the nano-precipitates formed in the ferrite of Nb steels is still subject to debate, mostly due to its experimentally challenging nature. In addition, direct strip casting is a revolutionary casting technique that integrates casting and subsequent rolling together with rapid solidification and cooling rates, which not only simplifies the process, but also confers superior energy-saving as compared to conventional alloy thermomechanical processing. In this work, therefore, we have studied the effect of Mo on the precipitation in the ferrite of a Nb-containing micro-alloyed steel produced by strip casting using various advanced characterisation techniques. Isothermal ageing treatments were carried out at 650 ℃ up to 10,000 s to form precipitates, and the strength was measured using shear punch test. Transmission electron microscopy (TEM) observation showed that precipitates were formed along dislocations in both steels with and without Mo. Atom probe tomography (APT) analyses revealed that the addition of Mo increased both size and volume fraction of solute clusters after short ageing times, which provided a much higher cluster strengthening. Precipitation of Nb-rich carbonitrides were found after longer ageing treatments. However, no significant Mo was observed to segregate to the precipitate. Small-angle neutron scattering (SANS) results indicated that the addition of Mo reduced the average precipitate size. X-ray diffraction (XRD) results suggested that this was attributed to the higher dislocation density that increased the number of nucleation sites.

This work has been published in:
L. Jiang, R.K.W. Marceau, B. Guan, T. Dorin, K. Wood, P.D. Hodgson, N. Stanford, The effect of molybdenum on clustering and precipitation behaviour of strip-cast steels containing niobium, Materialia 8 (2019) 100462.

Speakers Gender

Male

Level of Expertise

Early Career <5 Years

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