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Publication date
2017

Document Version
Final published version

Citation (APA)
Ayenampudi, S., Celada-Casero, C., Sietsma, J., & Santofimia, M. J. (2017). *Microstructural evolution during high-temperature partitioning of a medium-Mn Q&P steel*. EUROMAT, Thessaloniki, Greece.

Microstructural evolution during high-temperature partitioning of a medium-Mn Q&P steel

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ABSTRACT:

Medium-Mn Quenching & Partitioning (Q&P) steels have been recently considered as potential candidates for the 3rd generation Advanced High-Strength Steels. With the application of the adequate Q&P process they can possibly utilize the diffusional behaviour of both interstitial and substitutional elements to increase the austenite stability. The goal of the present study is to investigate the microstructural evolution and stabilisation process of the austenite at high partitioning temperatures, where the diffusivity of substitutional alloying elements is sufficient for partitioning. A 0.31C-4.58Mn-1.52Si (in wt. %) steel was subjected to full austenitization at 950 °C, quenching to 190 °C and isothermal holdings in the range of 400-600 °C for times up to 1 hour. The microstructural characterization was done by means of dilatometry, optical and electron microscopy and X-ray diffraction. The degree of austenite stabilization during partitioning was determined based on the Martensite start (M_S) temperature detected in the final quench and two trends were observed. Partitioning at 400-450 °C gives rise to a decrease of the M_S temperature, as expected from the carbon redistribution between martensite and austenite. On the contrary, partitioning temperatures of 500-600 °C lead to a progressive increase of the M_S temperature, indicating that the austenite is being destabilized during partitioning. Both effects are enhanced by partitioning time. The latter behaviour is a consequence of overlapping phenomena activated at high partitioning temperatures, such as carbide precipitation and reverse transformation of martensite to austenite, that may counteract the stabilizing effect of both carbon and manganese partitioning. The results from the current research work indicate the complexity related to the high temperature partitioning process and broaden the scope for further investigation.