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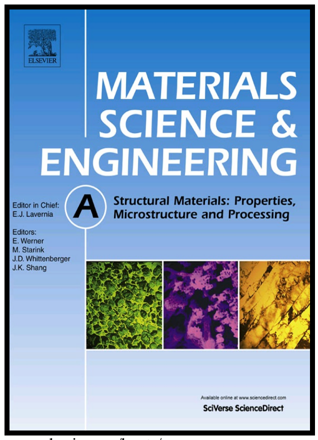

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ON THE RELATIONSHIP BETWEEN THE MULTIPHASE MICROSTRUCTURE AND THE MECHANICAL PROPERTIES OF A 0.2C QUENCHED & PARTITIONED STEEL.

Pierre Huyghe[1], Loic Malet[1], Matteo Caruso[2], Cédric Georges[2], Stéphane Godet[1]

[1]4MAT, Materials Engineering, Characterization, Processing and Recycling, Université Libre de Bruxelles, 50 Avenue FD Roosevelt, CP194/03, B-1050 Brussels, Belgium
[2]CRM – CRM Group, Avenue du Bois Saint Jean 21 P59, B-4000 Liège, Belgium

ABSTRACT

In the present work, Quenching and Partitioning (Q&P) heat treatments were carried out in a quench dilatometer on a 0.2 wt.% carbon steel. The microstructure evolution of the Q&P steels was characterized using dilatometry, SEM, EBSD and XRD. The martensitic transformation profile was analyzed in order to estimate the fraction of martensite formed at a given temperature below the martensite start temperature M_s. Q&P was shown to be an effective way to stabilize retained austenite at room temperature. However, the measured austenite fractions after Q&P treatments showed significant differences when compared to the calculated values considering ideal partitioning conditions. Indeed, the measured austenite fractions were found to be less sensitive to the quench temperature and were never larger than the ideal predicted maximum fraction. Competitive reactions such as austenite decomposition into bainite and carbide precipitation were found to occur in the present work.
Furthermore, a broad range of mechanical properties was obtained when varying the quenching temperatures and partitioning times. The direct contributions between Q&P microstructural constituents -such as retained austenite as well as tempered/fresh martensite- and resulting mechanical properties were scrutinized. This was critically discussed and compared to quenching and austempering (QAT) which is a more conventional processing route of stabilizing retained austenite at room temperature. Finally, Q&P steels were shown to exhibit an interesting balance between strength and ductility. The achievement of this interesting combination of mechanical properties was reached for much shorter processing times compared to QAT steels.

Keywords: Quenching and partitioning, austempering, phase quantification, retained austenite, mechanical properties.

1. INTRODUCTION

The automotive industry is mainly driven by requirements regarding the vehicle safety and the greenhouse gas emissions. Requirements on safety considerations have increased with the introduction of several test protocols by vehicle regulatory organizations. Simultaneously, vehicle manufacturers have to deal with issues such as environment, greenhouse gas emissions and fuel consumption. Amongst the different proposed strategies, the use of lightweight materials seems to offer the most promising advantages [1]. In order to stay competitive with respect to emerging materials such as Al-or Mg-alloys, polymers or composites, the steel industry has to continuously evolve and innovate. Therefore, complex steels in terms of processing, compositions and microstructures were introduced and called advanced high strength steels (AHSS) [2,3].