

# Table of Contents

<b>Chapter 1 Introduction .....</b>	<b>1</b>
<b>Chapter 2 Literature Review .....</b>	<b>3</b>
2.1 Quenching and partitioning processing .....	3
2.1.1 Quenching .....	4
2.1.2 Carbon partitioning .....	12
2.1.3 Final quenching .....	15
2.2 Stabilization of austenite .....	17
2.2.1 Chemical stabilization .....	17
2.2.2 Size stabilization .....	18
2.2.3 Mechanical stabilization .....	18
2.2.4 Thermal stabilization of austenite .....	19
2.3 Reactions competing with carbon partitioning – tempering of martensite .....	21
2.3.1 Tempering stages .....	21
2.3.2 Behavior of substitutional elements during tempering .....	24
2.3.3 Change of properties upon tempering .....	24
2.3.4 Tempering in nitrogen-added steels .....	26
2.3.5 Methodology for tempering investigation .....	27
2.4 Mechanical behavior of retained austenite .....	27
2.4.1 Dislocation glide .....	27
2.4.2 Transformation-induced plasticity (TRIP) effect .....	29
2.4.3 Twinning-induced plasticity (TWIP) effect .....	30
2.4.4 Stacking fault energy .....	31
2.4.5 Temperature dependence of tensile elongation in austenitic steels .....	32
2.5 Martensitic stainless steels .....	32
<b>Chapter 3 Experimental Procedures .....</b>	<b>35</b>
3.1 Processing history of raw materials .....	35
3.2 Dilatometry .....	36

Table of Contents

---

3.3	Light optical microscopy.....	38
3.4	Scanning electron microscopy .....	39
3.5	Transmission electron microscopy.....	39
3.6	Room and high temperature X-ray diffraction.....	39
3.7	Magnetic measurements.....	41
3.8	Atom probe tomography .....	41
3.9	Q&P processing of tensile specimens .....	42
3.10	Tensile tests.....	43
<b>Chapter 4 Results and Discussion.....</b>		<b>44</b>
4.1	Full dissolution point of alloy carbides in the austenite.....	44
4.1.1	Caliber-rolled microstructures .....	44
4.1.2	Carbide dissolution study based on the $M_s$ temperature.....	45
4.1.3	Carbide dissolution study based on the coefficient of thermal expansion (CTE)....	47
4.1.4	Influence of carbides fraction and size on the apparent coefficient of thermal stabilization during dissolution .....	50
4.2	Austenite stabilization mechanism and the influence of martensite fraction.....	52
4.2.1	Experiment series I with simple quench interruption .....	53
4.2.2	Experiment series II with reheating to 200 °C.....	55
4.2.3	Experiment series III with reheating to 450 °C .....	56
4.3	Reactions competing with carbon partitioning.....	63
4.3.1	Initial microstructures for the tempering investigation.....	63
4.3.2	Dilatometry analysis .....	66
4.3.3	High temperature X-ray diffraction analysis .....	70
4.3.4	Magnetic investigation.....	75
4.3.5	Summary of tempering reactions.....	83
4.4	Q&P processing of tensile specimens .....	85
4.4.1	Microstructures prior to tensile tests.....	85
4.4.2	Tensile properties in the fully austenitic condition.....	87
4.4.3	Tensile properties of Q&P-processed austenitic-martensitic steels.....	93
<b>Chapter 5 Highlights and Conclusions.....</b>		<b>103</b>

Table of Contents

---

5.1	Highlights.....	103
5.2	Conclusions.....	107
<b>Chapter 6 References .....</b>		<b>109</b>
	Acknowledgments.....	119
	List of abbreviations.....	120
	List of Tables.....	122
	List of Figures .....	123