Process Design for HSLA Steel and its Quantitative Measurement of Precipitation by Synchrotron XAS

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Abstract

Basic knowledge in thermodynamics of the precipitation of microalloying elements and Thermomechanical-Controlled Process (TMCP) have been applied for the process design of hot strip rolling for the strengthening effect, i.e., grain refinement and precipitation hardening. The vanadium-added high strength low alloyed (HSLA) steel shows satisfactory microstructures and mechanical properties for both classical ferrite-pearlite HSLA steel and ferrite-martensite dual phase steel. The tensile strength of ferrite-pearlite structure rises to over 600 MPa, which is superior to dual phase steel in terms of cooling scheme. On the other hand, quenching the second phase into bainite/martensite allows dual phase structure with a tensile strength well-above 700 MPa. Different cooling profiles are investigated for the strengthening effect and amount of precipitation. Fine precipitates of vanadium are firstly investigated by scanning transmission electron microscopy and Energy-dispersive X-ray spectroscopy (EDX). Vanadium in different forms is measured by synchrotron X-Ray Absorption Spectroscopy (XAS) carried out at Beamline 8 Synchrotron Light Research Institute (SLRI), Nakhon Ratchasima, Thailand. The specified phases of vanadium precipitates and the rest in solid solution form can be quantified using Linear Combination Fit (LCF) of the XAS spectra.

Keywords High Strength Low Alloyped (HSLA) steel, precipitation, synchrotron, X-Ray Absorption Spectroscopy (XAS)