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Selective Oxidation of 6Mn-2Si Advanced High Strength Steels during Intercritical Annealing Treatment

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Abstract : Advanced High Strength Steels are revolutionizing both the steel and automotive industries due to their high specific strength and ability to absorb energy during crash events. This allows manufacturers to design vehicles with significantly increased fuel efficiency without compromising passenger safety. To maintain the structural integrity of the fabricated parts, they must be protected from corrosion damage through continuous hot-dip galvanizing process, which is challenging due to selective oxidation of Mn and Si on the surface of this AHSSs. The effects of process atmosphere oxygen partial pressure and small additions of Sn on the selective oxidation of a medium-Mn C-6Mn-2Si advanced high strength steel was investigated. Intercritical annealing heat treatments were carried out at 690˚C in an N2-5%H2 process atmosphere under dew points ranging from –50˚C to +5˚C. Surface oxide chemistries, morphologies, and thicknesses were determined at a variety of length scales by several techniques, including SEM, TEM+EELS, and XPS. TEM observations of the sample cross-sections revealed the transition to internal oxidation at the +5˚C dew point. EELS results suggested that the internal oxides network was composed of a multi-layer oxide structure with varying chemistry from oxide core towards the outer part. The combined effect of employing a known surface active element as a function of process atmosphere on the surface structure development and the possible impact on reactive wetting of the steel substrates by the continuous galvanizing zinc bath will be discussed.

Keywords : 3G AHSS, hot-dip galvanizing, oxygen partial pressure, selective oxidation
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