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# Characterization and Prediction of Austenite formation and Decomposition in Steel Welds[a]

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Austenite formation and its decomposition control the final microstructure and performance of steel welds in the fusion zone (FZ) and heat-affected zone (HAZ) of the welds. Austenite formation in the FZ may occur either by equilibrium solidification of liquid to δ-ferrite and then solid-state decomposition of δ-ferrite to austenite or by direct nonequilibrium solidification of liquid to austenite. In the case of the HAZ, the austenite formation will be governed by the nucleation and growth of austenite from δ-ferrite + pearlite microstructure. The present paper will present an in-situ characterization of austenite formation and its decomposition in both the FZ and HAZ of Fe-C-Al-Mn steel using time-resolved X-ray diffraction with synchrotron radiation. Measurement of X-ray diffraction spectrum at a time resolution of 0.05 s allowed monitoring of the sequence of phase evolution in welds. In steel containing high-aluminum content, incomplete austenite formation from the ferrite +pearlite microstructure was observed in the HAZ. In contrast, in low-aluminum welds, complete austenite formation was observed in the the HAZ. In the case of the FZ at high cooling rates, nonequilibrium austenite formation from liquid was observed. However, at slow cooling rates, the equilibrium δ-ferrite formation was observed. Description of austenite formation and its decomposition using thermodynamic, kinetic and interface response function theories will be presented.

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