Microstructure and texture formation of AHSS produced via non-conventional technologies

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Abstract

The development of new processing routes in the steel industry is motivated by the global regulations that emerged, regarding the reduction of CO2 emissions. Thus, recent research and technological advances are oriented not only toward the development of new grades of AHSS that balance good mechanical properties but also toward a cost-effective and energy-saving manufacturing technique. Current "conventional" technologies for the thermal treatment of flat steel products (sheets and strips) on continuous annealing lines use hydrocarbon gases and /or electro-resistive heating that are not very effective and potentially polluting. The present research focuses on the evaluation of the microstructure, texture, and mechanical properties of advanced high-strength steel (AHSS) that was subjected to multiple intercritical annealing thermal cycles with conventional and ultra-high heating rates, intending to gain insight into the grain refinement effects and its influence on the mechanical properties. Two thermal pathways were designed and performed on an initial cold-rolled low-carbon steel, i.e., triple annealing cycles combined with ultra-fast annealing (TA&UFA), and a single ultra-fast annealing cycle (UFA). All experiments were carried out in a dilatometer with induction heating. The microstructure, texture, and hardness properties of the treated steel samples were evaluated. It was found that both multiple thermal cycling and UFH can produce steels with finer microstructure and higher hardness than the conventional one-step heat treatment technology. However, unexpected effects of texture weakening were observed in the steels after thermal cycling. Finally, results and conclusions are obtained regarding the effectiveness of the studied thermal routes as grain refinement techniques.

Keywords: advanced high, strength steel, ultra, fast annealing, thermal cycling, microstructure, grain refinement, texture, texture memory

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