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Abstract

A thermo-mechanical plasticity material model, which consists of a hardening and a temperature sensitivity term, is built to describe the dual phase DP600 steel behavior. For the hardening term, a synthesis Ludwik - Voce hardening law is proposed, identified and compared with the classical Ludwik and the Voce hardening laws. For the temperature sensitivity function, a new proposed expression together with a classical Johnson-Cook term and an improved Chen term are analyzed and identified. Moreover, the plate anisotropy of DP600 is also taken into account using Hill-48 theory. Based on the plasticity material model, a numerical sequential coupled thermo-mechanical model is applied to investigate the residual stresses of laser welding process. It is shown that the material anisotropy and the thermo-mechanical elastic-plastic model have an important influence on numerical residual stresses results. An experiment is also carried out to verify the numerical model. Simulation results of residual stresses are in good accordance with neutrons diffraction measurements.

Keywords: Constitutive Equations, Anisotropy, Laser Welding, DP600 Dual Phase Steel Behavior, Residual Stress, Neutron Diffraction

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