8th International Conference on Physical and Numerical Simulation of Materials Processing (ICPNS)

14–17 October 2016

Seattle, Washington | Hosted by Purdue University

SESSION 4: WELDING AND COATING, SALON E

Co-Chairs: Pingsha Dong, University of Michigan; Honggang Dong, Dalian University of Technology; Oksana I. Shpigunova, Tomsk State University

SUNDAY, OCTOBER 16, 2016

Prediction of the welding residual stress and distortion in 10Ni5CrMoV steel considering solid phase transformation effect

Yong Liu; Ping Wang; Hongyuan Fang, Harbin Institute of Technology

ABSTRACT

The objective of this paper is to figure out the influence of solid-state phase transformation on the evolution of residual stress distributions in 10Ni5CrMoV steel plate by an autogenous gas tungsten arc (GTA) welding process. A coupled thermo-mechanical finite element (FE) model was developed taking into account the effect of solid-state phase transformation. Effect of latent heat, volumetric change, yield strength change, and transformation induced plasticity (TRIP) due to austenite–martensite (A–M) transformation was investigated by means of numerical analysis. And the influence of stress on A–M transformation was considered. In order to maintain relevant parameters, physical simulation was conducted by GLEEBLE and extensive experimental testing was carried out. Meanwhile, the residual stresses of the welded plate were tested which are in good agreement with the simulation results. The results show that solid-phase transformation significantly affects residual stresses in the fusion zone and heat affected zone. Among all the factors induced by solid-phase transformation, volumetric change has a prominent influence on stress distribution, and yield strength change and TRIP affect residual stress magnitude to a variable extent.