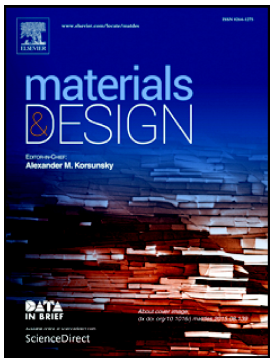

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The thermodynamic analytical models for steady-state of linear friction welding based on the maximum entropy production principle

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Abstract:

A simple model developed on clear physical bases always is one of the major challenges for the study of linear friction welding. Based on the thermodynamic framework extracted from the Onsager-Ziegler maximum entropy production principle (OZ-MEPP), a 2D analytical thermodynamic model is established to characterize the steady-state of the severe plastic deformation (SS-SPD) systems produced by LFW. The model has the features of self-consistency and directive prediction, which can successfully predict all of the response parameters for the SS-SPD system merely from the initial conditions (the welding parameters, sizes and thermo-physical parameters of the specimens). The model is examined by the corresponding experimental results of seven alloys, which indicates that the accuracy and generality of the model is satisfactory. Moreover, the model also provides a thermodynamic and quantitative explanation for the temperature distribution in the SS-SPD system, friction coefficient of stick friction and the direction of adiabatic shear.

Key words: Linear friction welding; Analytical model; Thermodynamics; Severe plastic deformation;