

"Overview of ORNL Welding Research"

J. M. Vitek

Oak Ridge National Laboratory

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Several basic welding research programs within the welding group in the Metals and Ceramics Division at ORNL will be reviewed. In particular, four research activities will be discussed. The first involves work with a hybrid laser-arc welding system. This is a joint project with three other national laboratories. ORNL's role has been to model the weld pool shape behavior as a function of weld parameters. This has been accomplished by using a neural network model to predict specific weld pool shape parameters and then use these parameters to predict the overall weld profile. A second area of research that will be reviewed is the prediction of ferrite number in stainless steel welds. A model that is significantly better than conventional constitution diagrams will be discussed. This model is based on a neural network and it considers the interactions between alloying additions when predicting ferrite content. A recent improvement that includes cooling rate effects will also be presented. The third subject will be the modeling of phase transformation behavior during solidification and subsequent cooling in the solid state. Recent calculations using computational thermodynamics and kinetics will be considered. Calculations using a para-equilibrium model will also be discussed. Current limitations and areas for future work will be presented. The final research topic will be the welding of single crystal alloys, and in particular single crystal nickel base superalloys. The problems and challenges facing the implementation of welding techniques for repair of single crystal materials will be reviewed.

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