E0027

Simultaneous *In-Situ* Neutron Diffraction Measurement of Rapid Transient Temperature and Stress Fields. Z. Feng[a], W. Woo[b], X-L. Wang[a], D.W. Brown[c], B. Clausen[c], K. An[a], C. Hubbard[a], H. Choo[b], S. A. David[a], [a]Oak Ridge National Laboratory, Oak Ridge, TN, [b]Univ. of Tennessee, Knoxville, TN, [c]Los Alamos National Laboratory, Los Alamos, NM.

We present a novel experimental approach and results of direct, experimental measurement of the temperature and thermal stress *inside* the stir zone during friction-stir welding (FSW) of 6061-T6 aluminum plate using *in-situ* neutron diffraction measurements. This novel technique is based on the "quasi-steady state" phenomenon induced by moving, localized thermomechanical processing of the material of interest. The quasi-steady state circumvents the neutron flux limitation for studying the rapid transient material behavior. A specially designed portable thermomechanical processing system based on the friction stir welding process was designed and built for this test. Decomposition of the thermal and elastic strains from the lattice spacing changes measured using the neutron diffraction, for the first time, revealed the transient temperature and stress state under the tool shoulder during the FSW.

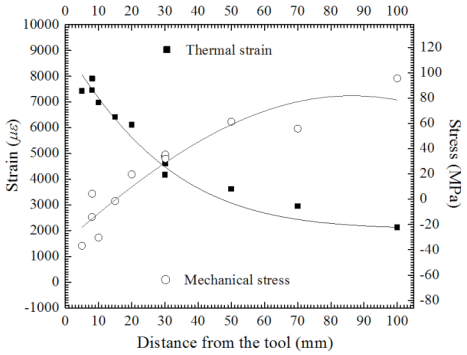

Figure 1. Thermal strain and longitudinal stress variation as function of distance from welding zone as determined from in-situ neutron diffraction experiment

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