

"In-Situ Monitoring of Arc Welding Using Synchrotron-Based X-Ray Diffraction Techniques

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Abstract

Understanding the evolution of microstructure in welds has been an important goal of contemporary welding research because of the strong correlation between weld microstructure and weld properties. To achieve this goal it is important to develop a quantitative understanding of various phase transformations encountered during welding in order to ultimately develop methods for predicting weld microstructures. To aid in this effort, synchrotron radiation methods have been developed at Lawrence Livermore National Laboratory for direct observations of microstructure evolution during welding.

This intense, highly collimated radiation, is millions of times more powerful than conventional x-ray tubes, and can be used to probe atomic structures in milliseconds rather than hours required by conventional sources. Using two synchrotron-based techniques, known as spatially resolved (SRXRD) and time resolved (TRXRD) x-ray diffraction, real-time x-ray diffraction is used to directly observe localized phase transformations in the heat affected zone and fusion zone during welding. These techniques have been used to investigate titanium alloys, low alloy steels and stainless steel alloys, and this presentation will provide a brief overview of some of our recent results.

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