In-situ phase mapping and real-time chemical dynamics using a novel SRXRD technique

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Advantage is taken of the progressively increasing photon fluxes from second-plus generation synchrotron radiation sources to develop a number of diffraction and spectroscopic techniques to follow the chemical dynamics, phase transformation and structure of solids with better and better temporal and spatial resolution. Time resolution has drastically been improved from the conventional minutes-and-hours time scale to the milliseconds regime [1]. In this paper, a SRXRD (spatially-resolved x-ray diffraction) probe using a focused beam from a powerful 31-pole wiggler beamline [2] at Stanford Synchrotron Radiation Laboratory will be described. The results of mapping the allotropic transformation of Ti from the α- to β-phase in a narrow region of the so-called heat-affected zone in a fusion weld [3] *in-situ* and *in real-time* during the welding process will be presented. A refined version of SRXRD using imaging plates will be discussed. This new SRXRD capability opens up new experimental opportunities to study phase transformations with sub-millimeter spatial resolution and reactivity of solids under steep thermal gradients and non-isothermal conditions. With the availability of third-generation synchrotron sources, spatial resolution of the order of microns will be achieved.

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[2] V. Karpenko et al. Rev. Sci. Instrum. **60**, 1452 (1989).
[3] J. W. Elmer et al. Tran. Met. Mater. **27A**, 775 (1996); J. Mater. Sc. (1996) in press.