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Development of a Neutron Radiography Beamline at the Manuel Lujan Jr. Neutron Scattering Center

M. Mocko[1] on behalf of collaboration

[1]LANSCE, Los Alamos National Laboratory, Los Alamos NM 87545, USA

mmocko@lanl.gov

Abstract

Neutron imaging and tomography has been in existence for over five decades and has grown in use and application tremendously over the last decade. This technique of nondestructive inspection and characterization is being predominantly used at reactor neutron sources around the globe. As of yet, the neutron radiography has not been widely deployed at short-pulse spallation neutron sources, despite clear benefits offered by a pulsed neutron source.

The neutron imaging technique can utilize the pulsed-neutron beam with intrinsically high timing resolution up to and including resonance energies, as well as the gammas naturally produced in the spallation process. The objective of our initiative is to develop a worldclass unique imaging facility that would become part of the Los Alamos Neutron Science CEnter (LANSCE) user facility program. Such a facility will find applications across a wide spectrum of research including (1) Post irradiation examination of nuclear fuel rods (e.g., study of variations in void growth, microscopic cracking in cladding, detection of large reaction zones at the clad/fuel interface), (2) Visualization of water movement in the reaction area of an operating fuel cell, (3) In situ study of the formation of clathratehydrates under realistic conditions, (4) Isotope and temperature maps of operating batteries, (5) Producing 3D phase and strain maps of welds, and many others, (6) Material identification and imaging using fast neutron and gamma radiography. These unique applications can be, of course, complemented by conventional white beam neutron radiography and tomography also possible with the proposed setup. Recently, a twodimensional neutron-sensitive detector system with excellent spatial (~50 micrometer pixel size) and timing resolution (~0.1 microsecond) was brought to LANSCE. It was demonstrated that such a system can merge the mature techniques of neutron nuclear resonance spectroscopy and Bragg-edge transmission yielding unprecedented imaging and tomographic applications. We will present the latest plans of our neutron radiography development effort and discuss some of the results obtained during the recent demonstration experiment done at the LANSCE user facility.