Neutron Imaging- A Nondestructive Diagnostic Tool for Material Science

Abstract: Neutron imaging is a powerful non-invasive technique in various applications for probing the internal structure of much thicker objects as well as for imaging of low Z materials. Particularly in situations, where penetration through x-rays is difficult, neutron imaging plays an important role. Manufacturers of complex parts through additive manufacturing processes or large high-density items that may not be well suited to x-rays finds the benefits of neutron imaging intriguing. Manufacturers of composite materials, turbine blade manufacturers, and manufacturers utilizing investment casting techniques are also interested to see how neutron radiography can find residual ceramic core material leftover from chemical leaching and dissolving processes. Neutrons are generated either from a neutron generating isotope (e.g. UW Madison nuclear reactor) in a reactor facility or from a deuterium-deuterium or deuterium-tritium neutron generator (e.g. Phoenix) or proton accelerator (e.g. SNS at ORNL). Depending on neutron energies, different neutron imaging systems can be developed. Usually the high-resolution (less than 10 µm) neutron imaging systems are developed with cold neutrons while the medium-resolution (usually 10 µm- 200 µm) neutron imaging systems can be developed with thermal neutrons. For dense samples that are not easily penetrable, mm-range resolution neutron imaging systems can be developed using fast neutrons. With the combination of X-ray and neutron imaging, the fusion between X-ray and neutron imaging can provide more insight about the materials. This talk will discuss Dr. Abir’s experience in developing several neutron imaging systems at different facilities in the United States. This talk will also discuss the usefulness of X-ray and neutron image fusion for the routine inspection of materials.

Biography: Muhammad Abir, Ph.D. is working as an Imaging Specialist at Phoenix, LLC in Monona, WI. His research focuses on designing and developing state-of-the-art radiation imaging systems to gain insight into materials nondestructively. He is particularly interested in designing optics for high-resolution neutron imaging, developing high-resolution neutron imaging systems for highly dense materials and radioactive materials as well as multi-modal radiation imaging systems, improve image quality using image processing and analysis, and analyze big data using machine learning. Dr. Abir received several DOE grants for developing radiation imaging systems for nuclear fuels. Dr. Abir received his bachelor’s degree in mechanical engineering from Bangladesh University of Engineering and Technology (BUET) in 2009. He received his master’s and Ph.D. degree in nuclear engineering from Missouri University of Science and Technology (Missouri S&T) in 2011 and 2015, respectively. Dr. Abir has more than 9 years of experience in working on radiation imaging. Prior to joining Phoenix, Dr. Abir worked at the Nuclear Reactor Laboratory at the Massachusetts Institute of Technology and Materials and Fuels Complex at the Idaho National Laboratory as a Postdoctoral Research Associate.

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