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Abstract for an Invited Paper
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Advanced Neutron Imaging and Scattering Techniques Using Multiple Modalities and Contrast for Studying Natural and Advanced Materials[1]

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Novel neutron imaging techniques, a majority of them using energy selective neutrons, now offer the possibility to study the microstructure of engineering materials. This work will summarize recent research on neutron imaging based on contrasts resulting from attenuation, phase, dark-field, and diffraction. The major collaborators and user facilities are identified to acknowledge their significant contributions to these studies.

- Strain mapping exploiting Bragg Edges will be discussed based on experiments performed at Helmholtz Zentrum Berlin (HZB: N. Kardjlov, A. Hilger, I. Manke; ESS: M. Strobl) using a tunable monochromator device, at ISIS (J. Kelleher) and LANSCE (Bjørn Clausen) using the time-of flight approach in collaboration with A. Tremsin (UC Berkley).

- Bragg Edge based neutron imaging was used to monitor TRansfomation Induced Plasticity (TRIP) effect and localization effects, which remain undetected by other techniques, have been noticed for the first time using high resolution setup at CONRAD.

- Three dimensional grain mapping techniques developed at synchrotron sources, such as 3D-XRD and Diffraction Contrats Tomography (DCT), just opened numerous new applications for studying crystalline materials. The extension of the technique to neutrons will be discussed and data taken at HZB and NIST (D. Hussey, D. Jacobson) in close collaboration with ESRF (W. Ludiwg, P. Reischig) will be shown.

- 3-D simulations of multi-phase flow through porous media and verification using high resolution x-ray and neutron tomography data obtained at HZB (N. Kardjlov, A. Hilger, I. Manke) and NIST (D. Hussey and D. Jacobson). Recent experiments using larger diameter specimens at coarser resolution using PSI (P. Vontobel and E. Lehmann) imaging facility will also be discussed. Combined modality of using X-rays to precisely define solid phase, use of neutrons to identify water phase, and both modalities to identify gas phase spatially and temporally shows much promise for studying transport through porous media type problems.

- The importance of efficient and gamma insensitive thin neutron scintillators with rapid decay time will be discussed. Promising polymeric scintillator films developed by Penumadu's group and characterized at CG-1 facility at Oak Ridge National Laboratory (H. Bilheux) will be presented.

Many of the measurement techniques are still in the development stage and the targeted presentation will also define the needs for further improvements, so that existing and future neutron imaging facilities will be beneficial for a diverse and