MECHANICAL & MATERIAL COLLOQUIUM

Under Pressure: What Neutrons Reveal in Functional Materials

by Dr. Christopher Ridley (Oak Ridge National Laboratory)

The devil is usually hidden in the details—but what if we aren't looking in the right place? Neutrons offer powerful complementarity to other structural probes such as X-rays and electrons and, coupled with measurements including Raman spectroscopy, magnetometry, and electrical transport, can provide unique insight into how material structure governs properties. Many functional materials contain a mixture of heavy and light elements (e.g. H, Li, O, N), and most deviate significantly from the 'ideal' case; phase impurities, compositional inhomogeneity, and differences between bulk- and surface-structure can all complicate microprobe analysis. Only neutrons combine extreme sensitivity to light elements with the ability to probe truly bulk samples. In this talk, I will introduce the fundamentals of neutron diffraction and highlight the resources available at Oak Ridge National Laboratory. I will present example studies from my own research, demonstrating how neutron diffraction can be combined with extreme conditions, high temperature and multi-gigapascal pressures, to uncover counter-intuitive structural behavior inaccessible to other techniques.

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Dr. Christopher Ridley is a researcher at the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL, Tennessee), where he works as an instrument scientist on SNAP, the dedicated extreme-conditions diffractometer and one of only a handful of such instruments worldwide. His research uses neutron crystallography to understand how structure influences material properties under pressure, with recent work focusing on lithium compounds relevant to Li-ion battery production and the phase behavior of simple molecular systems. This has led to a more recent focus on the curious case of 'negative linear compressibility' materials. Prior to joining ORNL, he was a neutron instrument scientist at the Rutherford Appleton Laboratory (RAL, Oxford, UK). He received both his M.S. and Ph.D. in physics and engineering from the University of Edinburgh.

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For questions, comments and suggestions, contact Colloquium Organizers Dr. Saja AL Rifai (salrifai@fiu.edu) or Dr. Jiuhua Chen (chenj@fiu.edu)