Neutron Scattering Focus Topic
Room: East Exhibit Hall - Session NT-TuP

Neutron Scattering Poster Session

NT-TuP1 High Pressure and High Temperature Neutron Reflectometer Cell for Solid-Fluid Interface Research, ***P. Wang***, *D. Hickmott, A. Lerner, J. Majewski*, Los Alamos National Laboratory

To understand the interfacial behaviors of materials under high pressure (P) and temperature (T) are of great importance and interest since lots of natural phenomena and practical applications involve those conditions. For instance, mineral surface/fluid interactions control success or failure of many attempts to engineer Earth's subsurface for energy and/or environmental applications. The corrosion of metals and alloys in high subcritical aqueous systems, and especially in supercritical environments is an important safety issue in nuclear power plants.

However, due to the fact that most interface characterization techniques are difficult to implement at elevated P-T, little experimental attention has focused on solid/fluid interfaces at high P-T.

Neutron reflectometry (NR) is increasingly being used as a characterization tool to study the surface/interface of planar substrates. SPEAR at Lujan center is a Time-of-Flight (ToF) NR facility which is specifically designed to study solid-liquid interface and is able to in-situ monitor the surface/interface behavior with a space resolution of a few angstroms. The obtained real space model from reflectivity curve fitting can provide a lot of physical and chemical information about the interface.

One key gap to study the interfacial behaviors of materials under high P-T conditions is the lack of well designed pressure cell capable of handling P-T conditions close to or above supercritical conditions. To build up the capability of studying high P-T surface/interface, Lujan Center developed a special designed pressure cell which allows us to reach 200 MPa and 250 °C (in the future such cell will be equipped with with *in-situ* spectroscopic Raman and IR capabilities). Neutron is highly penetrating, which is able to "see through" high P-T aluminum cell walls and examining the surface/interface properties. Besides the pressure cell itself, the high P-T cell system includes three other subsystems: temperature, pressure and sample chamber environment control systems.

NT-TuP2 Polarized Neutron Reflectivity of Exchange Inversion Layers, ***H. Lee***, *J. Yu, N. Pachauri, S. Keshavarz, P. LeClair, G.J. Mankey*, University of Alabama, *H. Ambaye, V. Lauter*, Oak Ridge National Laboratory

Bulk FeRh undergoes an antiferromagnetic to ferromagnetic phase transition as it is heated above room temperature. The addition of Pd lowers the phase transition temperature so that, in thin film form, the details of the phase transition can be studied while maintaining the same structural and morphological properties of the as-deposited film. The FeRhPd thin film was prepared by DC magnetron sputtering in an ultraclean sputtering system. A FeRhPd/Pt/FeRhPd trilayer was grown at 600ºC on an a-axis sapphire substrate with a Rh seed layer and a Pt buffer layer. The epitaxial orientation of this 111-oriented thin film was confirmed by X-ray diffraction methods including standard high-angle diffraction, rocking curve analysis and pole figure analysis. The first-order metamagnetic phase transition and thermal hysteresis of the magnetic moment were examined by vibrating sample magnetometery. To study the detailed magnetic structure of a trilayer with a Pt spacer between two epitaxial films we applied polarized neutron reflectivity (PNR). PNR is used to detect the magnetic moment distribution in layered structures. Temperature-dependent PNR showed the dependence of ferromagnetic spin-splitting for the neutron reflectivity of the two spin polarization channels. Fitting of the PNR data shows a change of the spin splitting that is consistent with vibrating sample magnetometry data. PNR measurements at two different applied magnetic fields of 1 T and 0.5 mT revealed the dependence of magnetic splitting on applied magnetic field and a modification of the thermal hysteresis. This data confirms the strong field dependence of the magnetically stable state. Analysis of the off-specular neutron reflectivity data will show how the magnetic domains change with experimental conditions. The authors gratefully acknowledge financial support from DOE award DE-FG02-08ER46499. Research at Oak Ridge National Laboratory's Spallation Neutron Source was sponsored by the Scientific User Facilities Division, Office of Basic Energy Sciences, U.S. Department of Energy.

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