Measuring the elastic properties under simulated Earth's mantle conditions

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The Earth's mantle is only accessible by indirect methods, above all seismological studies. The interpretation of seismic data from the Earth's deep interior requires measurements of the physical properties of Earth materials under experimental simulated mantle conditions. In principle there are 2 common ways of simulating these *in situ* conditions by high pressure techniques - diamond anvil cells (DAC), large volume presses (LVP). The latters are more limited in pressure, but provide sample volumes 3 to 7 orders of magnitude bigger. They also offer small and even adjustable temperature gradients over the whole sample. Ultrasonic interferometry allows the highly precise travel time measurement at a sample enclosed in a LVP under *in situ* conditions. The data transfer function technique (DTF) even makes transient measurements possible. From geophysical point of view the up to 6 orders of magnitude lower frequency range as used for optical techniques in DAC and the option of using complex samples, i.e. polycrystalline, polyphase mineral assemblages, make the results much more representative for comparison with field data. Simultaneous structural and deformation measurements require the installation at a 3rd generation synchrotron light source. We present recent techniques and results of elastic properties measurements performed at different large volume presses.

Using Ambient Pressure X-ray Photoelectron Spectroscopy to investigate the reduction of c(2x2)-O/Ni(100) by hydrogen

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X-ray Photoelectron Spectroscopy (XPS) is a powerful tool for the chemical analysis of surfaces. Typically XPS measurments are performed under ultra-high vacuum conditions, which are far removed from many environmental or technologically relevant conditions. The development of synchrotron based Ambient Pressure XPS (AP-XPS) that incorporates a differentially pumped electrostatic lens system into the electron energy analyzer has made possible XPS measurments at pressure up to about 5 Torr. In this presentation, after a brief introduction to the AP-XPS technique, results using AP-XPS to investigate the reduction of a chemisorbed oxygen layer on Ni (100) by hydrogen will be discussed.

Among transition metal oxides, NiO has been the focus of extensive fundamental studies due to its applications in catalysis and potential magnetic devices. The reduction of NiO has been studied at elevated pressure conditions using a broad range of techniques including X-ray Diffraction [1], and Near Edge X-ray Absorbtion Spectroscopy [2] among others. Relatively unexplored is the reduction of chemisorbed oxygen on the surfaces of Ni single crystals at elevated pressures.

We have investigated the reduction of the c (2x2)-O chemisorbed layer on Ni (100) using AP-XPS at temperatures from 100 °C to 150 °C and pressures up to 0.5 Torr. The presence of small NiO clusters, located at step edges as shown by scanning tunneling microscopy, have a significant impact on the reduction kinetics of the c (2x2)-O layer. These clusters are preferntially reduced compared to the c (2x2)-O layer and increase the reduction rate of the c (2x2)-O layer, quite likely from spill-over of dissociated hydrogen from the NiO islands.

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