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High pressure mineral physics in multi-anvil devices: In-situ ultrasonic interferometry, XRD and X-radiography

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During the last few years the resolution and amount of seismic data from the Earth's deep interior increased dramatically. The interpretation of these data requires measurements of the physical properties of Earth materials under experimental simulated mantle conditions. The high-pressure multi-anvil device MAX80 located for in-situ XRD experiments at HASYLAB (Electron Synchrotron at Hamburg), is now equipped for simultaneous XRD and elastic property determination under high pressure and high temperature conditions.

We use ultrasonic interferometry to measure the travel times with high precision. In addition to travel times, the determination of wave velocities requires the knowledge of the exact sample length under in situ conditions. Therefore the single-stage multi-anvil apparatus MAX80 was recently equipped for performing X-radiography [1]. The alternating use of X-ray diffraction and X-radiography in one high pressure experiment required to substitute the fixed slit system of MAX80 by a stepper motor-driven 4-blade high precision slits system. A Ce:YAG-crystal (IKZ) converts the X-ray shadow graphs to optical ones, redirected by a mirror imaged by a microscope and captured by a CCD-camera. To derive the sample length, the difference in brightness of sample, buffer rod and reflector is evaluated by image processing [2]. In case of similar X-ray absorption a gold foil at the interfaces is used as marker, and as ultrasonic couplant at the same time.

To enable transient ultrasonic measurements the very time consuming classical digital sweep method was added by an ultrasonic transfer function technique (UTF), related to the method described by Li et al. [3]. Instead of about 2 h for sweeping, saving the response of the system requires few seconds. Details how to optimize the excitation function and how to evaluate the response are described [4].

Some recent results on the non-quenchable high-P – low-P clinoenstatite transition and to the quartz-coesite transition will be given to discuss the different interferometric techniques, including the XRD-data and X-radiography results, necessary to detect the phase transitions under in situ conditions and to measure the sample deformation.

Within the next few months a double stage multi-anvil device (MAX2000x) for in-situ XRD measurements will be installed at HASYLAB as an additional tool for European high pressure mineral physics.

[1] Li et al, *NSLS Activity Report* ***2001***, 2-103-106.

[2] Mueller *et al*., In: J. Chen, Y. Wang, T. Duffy, G. Shen, L. Dobrzhinetskaya

(eds.), Frontiers in High Pressure Research, Elsevier Science, in press, (2004a).

[3] Li et al., Phys. *Condens. Matter* ***2002***, 14, 11337-11342.

[4] Mueller *et al*., In: J. Chen, Y. Wang, T. Duffy, G. Shen, L. Dobrzhinetskaya

(eds.), Frontiers in High Pressure Research, Elsevier Science, in press, (2004b).