High-pressure behavior of CaF_2 nanocrystals

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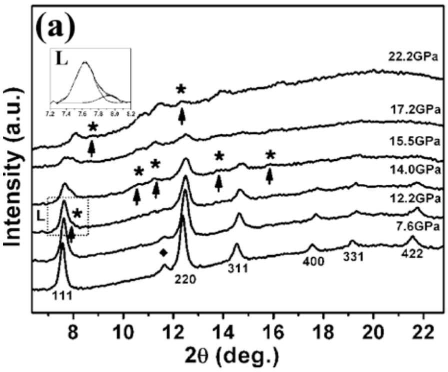
The alkaline-earth fluoride CaF_2 is a well-known face-centered- cubic ionic minerals, and has long been used as mineralogical models for the behavior of ionically bonded minerals in the Earth's mantle [1]. It is widely accepted that the actualization of nanosized materials have opened doors for finding new properties with respect to their macroscopic counterparts. Although there are many high-pressure studies on bulk CaF_2, pressure induced structural phase transitions in nanoscale system has rarely been reported [2, 3].



High-pressure behavior of nanocrystalline CaF_2 samples with an average grain size of 8 nm have been studied by *in situ* synchrotron radiation x-ray diffraction. A pressure-induced fluorite structure to orthorhombic $PbCl_2$-type structure transition starts at 14.0 GPa, and phase transition is sluggish. The orthorhombic phase of nanocrystalline CaF_2 is stable up to 46.5 GPa. The enhancement of transition pressure in CaF_2 nanocrystals as compared with the corresponding bulk material is mainly caused by the surface energy difference between the phases involved.

[1] Abby Kavner (2008) *Phys. Rev. B* **77**, 224102. [2] X. Wu, S. Qin & Z. Y. Wu (2006) *Phys. Rev. B* **73**, 134103. [3] E Morris, T Groy & K Leinenweber (2001) *J. Phys. Chem. Solids* **62**, 1117.

Elastic properties of hydrous and anhydrous mantle minerals at high pressure

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Anyhdrous and hydrous forms of wadsleyite and ringwoodite, high-pressure phases of $(Mg,Fe)_2SiO_4$ +- H_2O, are major constituents of the transition zone of Earth's mantle, and are likely abundant in many subducting slabs. Therefore, the seismic properties of these phases are essential to understand the chemical and thermal state of these regions, as well as the seismic signature of water in the mantle to 660 km depth. We have measured the acoustic wave velocities of several key anhydrous and hydrous forms of these minerals up to transition zone pressures by Brillouin spectroscopy on samples compressed in a diamond anvil cell. Hydrous samples contained roughly 2% by weight of H_2O. These experiments allow us to assess the effects of pressure, Fe and H_2O on the elastic properties of these phases. These measurements should provide insight on key questions such as the olivine content and hydration state of the transition zone. It appears that one of the critical issues in addressing the effects of hydration on these phases is the accurate measurement of water content. Our results indicate that determinations of the structurally-bound hydrogen content by SIMS and IR spectroscopy on these samples can vary greatly.