MS21-O4 Effect of various pressure media on the compressibility of the pressure standard quartz

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The diamond-anvil cell (DAC) technique has been successfully implemented to generate high pressures for *in situ* investigations. To compress material hydrostatically an appropriate pressure transmitting medium is required, which does not interact with the samples. Because of its simple loading, 4:1 methanol-ethanol mixture is most commonly used, but inert noble gases (such as argon, neon and helium) grow in popularity. However, helium is well known to interact with open framework structures like zeolithes[1] as well as with compact structures like olivine[2] due to its ability to interpenetrate crystals as a consequence of its small atomic radius. In addition, helium atoms even diffuse into the diamond anvils and make them mechanically brittle[3]. The applied pressure in the chamber of the DAC is measured by means of pressure sensors; the most prominent materials are ruby[4] and quartz[5]. Using the precisely determined equation-of-state (EoS) parameters of quartz, pressures can be derived. Compared to the dense structure of hcp-packed oxygen atoms in ruby, the structure of quartz represents a relatively open framework. Thus, the question arises to what extent noble-gas atoms intercalate and simultaneously stiffen the quartz structure relative to EoS parameters reported for quartz in non-penetrating pressure media[5]. The aim of this study is to determine the EoS parameters of quartz relative to volume and R-line shifts of ruby on compression in 4:1 methanol-ethanol, argon, neon and helium. Series of comparative compressibities up to 10 GPa have been performed on a (10-10) orientated quartz crystal, which was loaded together with two different ruby crystals (each one in (11-20) and (0001) orientation). Apart from the positions of the R1 lines of both ruby crystals the unit-cell parameters of all sample crystals were measured in order to determine the EoS parameters through fitting the data to an appropriate Birch-Murnaghan equation. A comparison of the results obtained from the analogous experiments carried out in different pressure media will be presented.

References

[1] R.M. Hazen and L.W. Finger; Journal of Applied Crystallography, 14, 234-236 (1981).

[2] R.T. Downs et al.; Mineralogical Society of America, 81, 51-55 (1996).

[3] A. Dewaele et al.; Journal of Applied Physics, 99, 1-5 (2006).

[4] H.K. Mao et al.; Journal of Geophysical Research, 91, 4673-4676 (1986).

[5] R.J. Angel; Journal of Applied Crystallography, 30, 461-466 (1997).

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