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Limit of hydrostaticity in He and Ne determined by means of in situ single crystal x-ray diffraction

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An ultrahigh-intensity rotating anode FR-E+ SuperBright from Rigaku coupled with a Huber four circle diffractometer and VariMaxTM focusing optics has been used to determine accurate and precise lattice parameters of very small single-crystals in diamond anvil cells at pressures above 40 GPa in a conventional laboratory. The optics are focusing the X-ray beam at the sample position (800 mm from the aperture of the optics) to the spot of about 200 μm size with high resolution (as measured by the sharp reflections line widths). The intensities of reflections from any crystal are at least 30 times larger than those obtained for the same sample with a similar x-ray diffractometer equipped with a conventional x-ray tube. However, accurate and precise lattice parameters at high pressure can be obtained only under hydrostatic or at least very close to hydrostatic conditions in order to avoid broadening of the reflections. To test the quasi-hydrostatic limits of He and Ne we have therefore performed a study of single crystals of quartz up to amorphisation of the sample and MgO single crystals. The study of these materials has also the advantage of being able to obtain compare the pressure scale of these two very well known materials with that of the ruby scale which appears to be dependent on the pressure medium used.