Equations of state of metals at ultrahigh pressure

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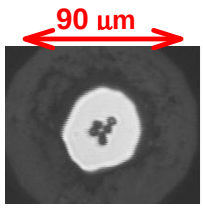
Compression versus pressure at ambient temperature has been measured for several metals (Be, Al, Fe, Co, Ni, Cu, Zn, Mo, Ag, Ta, W, Pt, Au) under quasi-hydrostatic conditions in a diamond anvil cell, up to at least 65 GPa and at a maximum pressure of 153 GPa (see figure below). Standard synchrotron x-ray diffraction accuracy in the volume determination could be achieved to the maximum pressure.

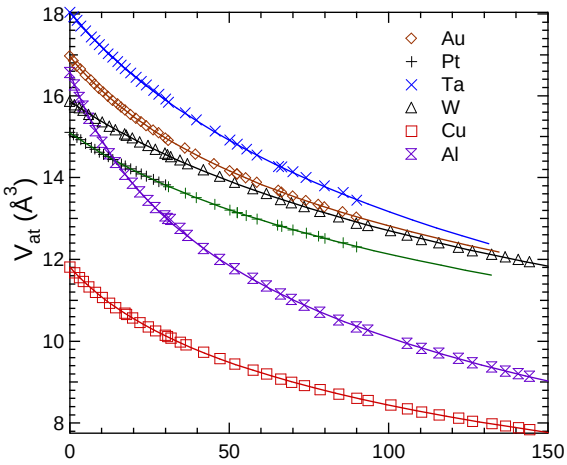
This data set can been used to re-calibrate the static pressure scale based on the ruby luminescence wavelength measurement [1]. The accuracy of various forms of luminescence wavelength vs. pressure in different pressure ranges will be discussed. In particular, this recalibration confirms recent suggestions of an underestimation of pressure by [1] at ultra-high pressure. We will show that using an updated pressure calibration, consistency between ultrasonic, dynamic and static measurements of the equations of state is improved [2].

This new consistency allows to test the predictive power of density functional theory, with different approximations, for equations of state calculations.



Sample geometry : grains of different metals, together with a ruby chip, embedded in helium.

Example of data obtained (see Ref. [2]) :



References:

[1] Mao *et al.,* J. Geophys. Res., 1986, **91**, 4673

[2] Dewaele *et al.*, Phys. Rev. B, 2004, **70**, 94112