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Static experiments above 5 Mbar

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The impact of high-pressure studies on fundamental physics and chemistry, and especially on the Earth and planetary sciences, has been enormous. While experiments in diamond anvil cells (DACs) at pressures of $\sim 250 - 400$ GPa are proven to be very difficult but possible, at higher static pressures any matter has not been investigated so until very recently [Ref. 1]. We have developed a method of synthesis of balls and semi-balls (of 10 to 50 μm in diameter) made of nanodiamond (with individual nano-particles of linear dimensions below 100 nm) and used them as second-stage or indenter-type anvils in conventional DACs. In experiments on rhenium, osmium, and gold we were able to generate pressures above 650 GPa [Ref. 1] and demonstrated crucial necessity of the ultra-high pressure measurements for accurate determination of the equation of state (EOS) of materials at extreme conditions.

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[1] L. Dubrovinsky, N. Dubrovinskaia, V. Prakapenka, A. Abakumov. Implementation of micro-ball nanodiamond anvils for high-pressure studies above 6 Mbar. *Nat. Commun.* 3:1163 doi: 10.1038/ncomms2160, 2012.