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Supplementary Materials for

Terapascal static pressure generation with ultrahigh yield strength nanodiamond

Natalia Dubrovinskaia, Leonid Dubrovinsky, Natalia A. Solopova, Artem Abakumov, Stuart Turner, Michael Hanfland, Elena Bykova, Maxim Bykov, Clemens Prescher, Vitali B. Prakapenka, Sylvain Petitgirard, Irina Chuvashova, Biliana Gasharova, Yves-Laurent Mathis, Petr Ershov, Irina Snigireva, Anatoly Snigirev

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This PDF file includes:

- fig. S1. Images demonstrating comparative hardness of NCD, single-crystal diamond, and NPD.
- fig. S2. Raman spectra collected from the diamond anvil over the tip of a semiball and at its edge.
- fig. S3. Reflectance IR spectra collected through and beside an NCD semiball compressed in a LiF medium at the IR2 beamline at ANKA Synchrotron.
- fig. S4. Variations of the lattice parameters of gold (red circles) and NCD of secondary anvils (blue squares) as functions of the pressure in the chamber.
- fig. S5. Optical photograph of the sample (Au and paraffin wax) compressed in a gasketed ds-DAC at 688(10) GPa, as seen through the diamonds and NCD secondary anvils.
- table S1. Observed and calculated *d* spacing of Au at 1065(15) GPa.

Supplementary Figures

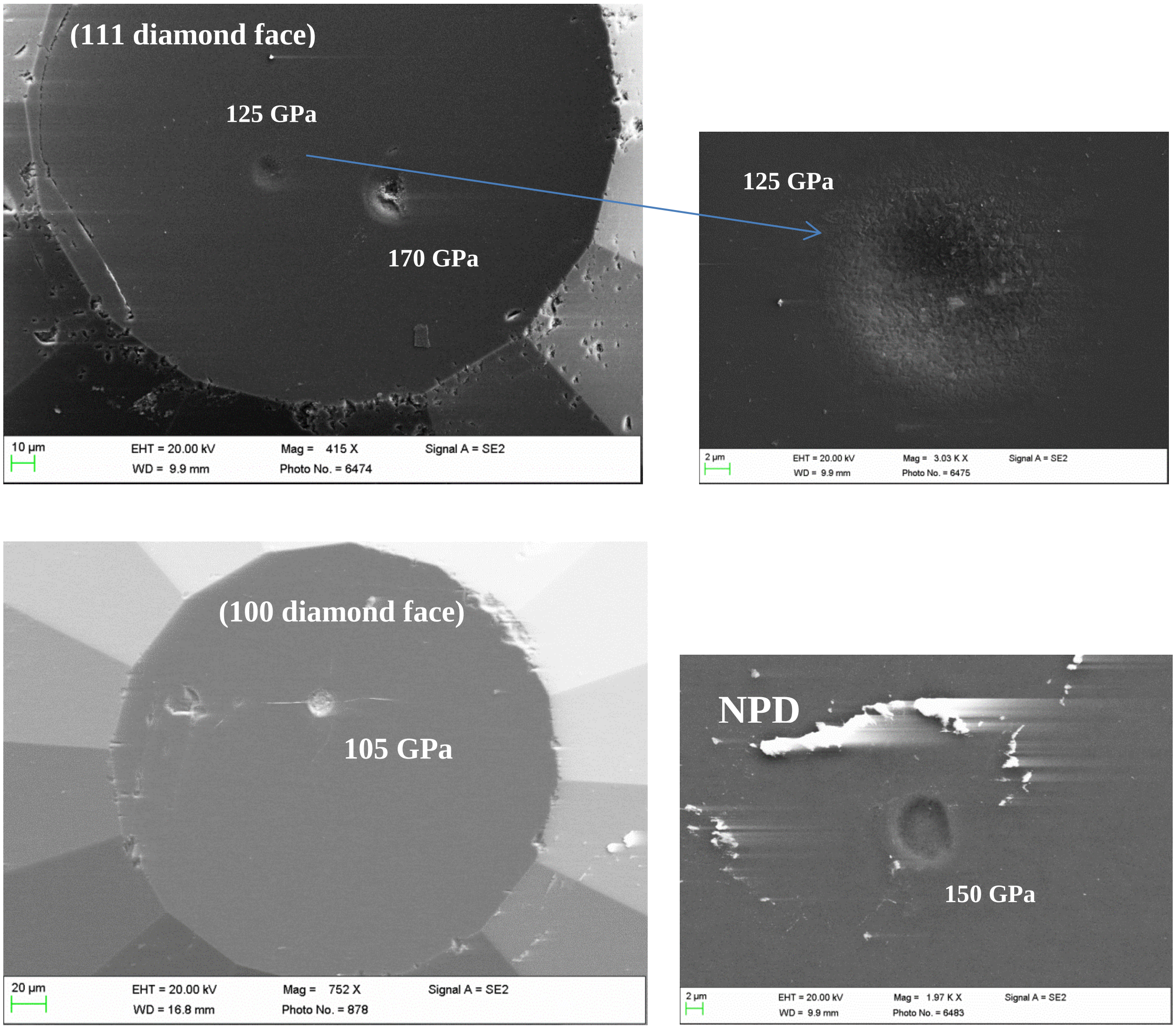

fig. S1. Images demonstrating comparative hardness of NCD, single-crystal diamond, and NPD. An NCD ball starts producing an indent on the (100), (111) diamond faces and on the surface of NPD (*17*) under applied loads (contact pressures) of 105, 125, and 150 GPa, correspondingly.

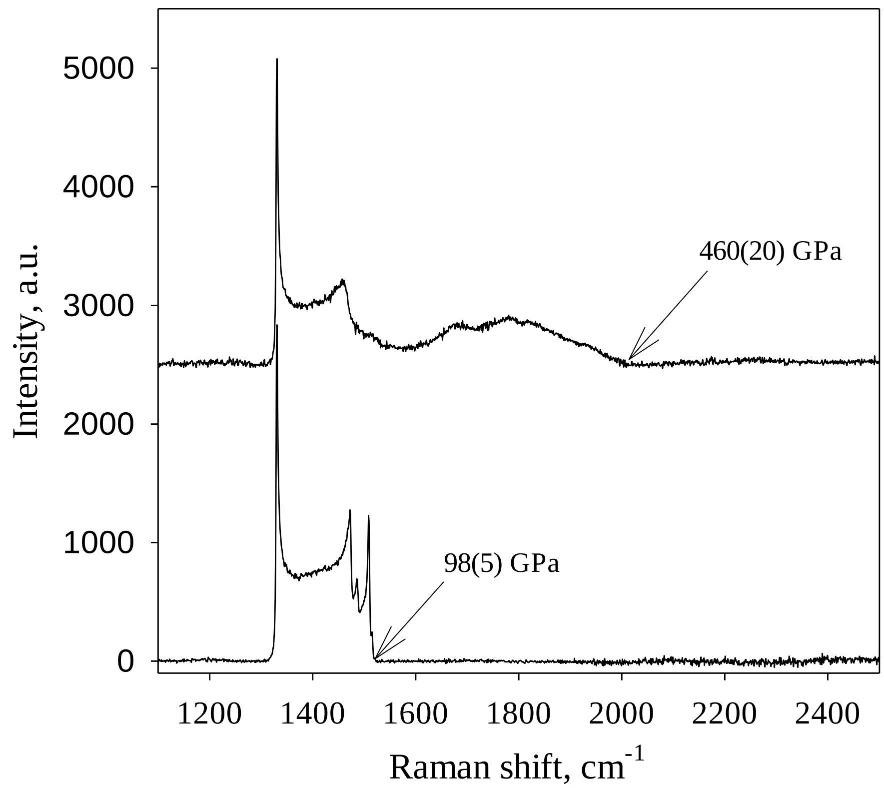

fig. S2. Raman spectra collected from the diamond anvil over the tip of a semiball and at its edge. The edge of the semi-sphere is about 6 μm away of its tip. The pressure under the tip is 4.5 times as high as that in the pressure chamber (for details of the pressure calibration of diamond anvil Raman gauge see (*26*)). The spectra were collected using Dilor XY spectrometer (confocal mode, x50 long working distance objective, Ar+ incident laser, 2 cm^{-1} spectral resolution).

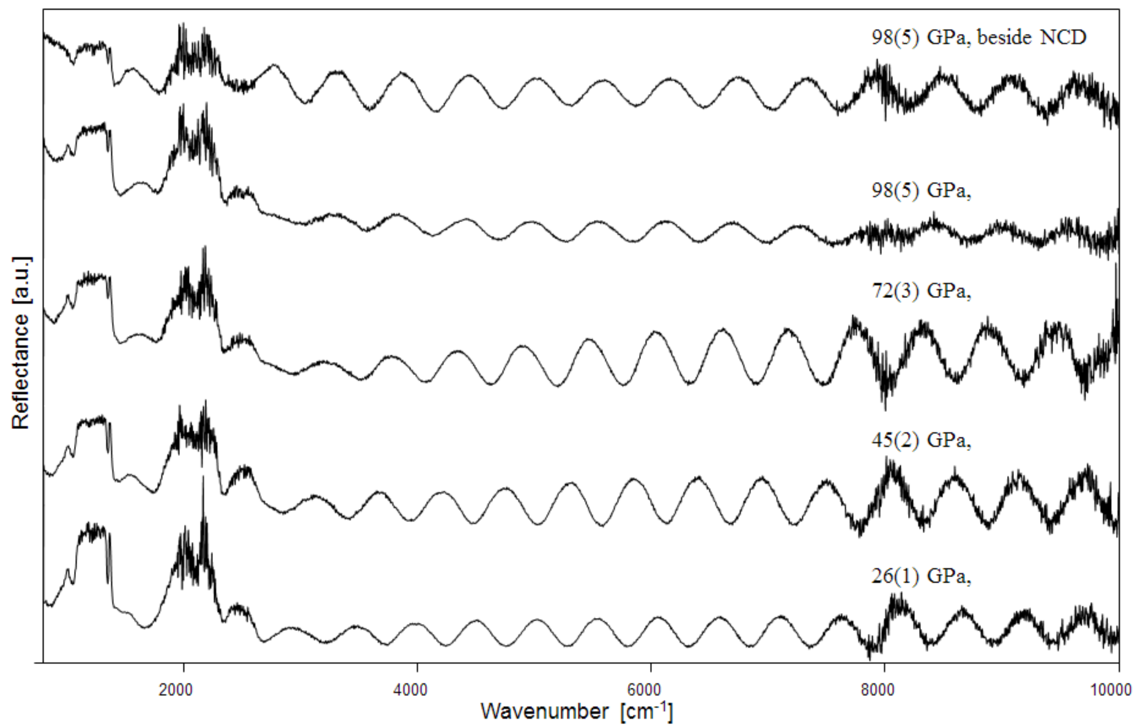

fig. S3. Reflectance IR spectra collected through and beside an NCD semiball compressed in a LiF medium at the IR2 beamline at ANKA Synchrotron. No contribution coming from NCD semi-spheres is visible as shown for the pressure of 98 GPa. The two graphs at 98 GPa were recorded beside the NCD semi-sphere (top graph) and through the NCD semi-sphere, respectively. The fringes are due to interferences between the surfaces of the diamond culets. Their period corresponds to a distance between the culets of approximately 4 µm. Pressure corresponds to the values measured in the LiF medium using a ruby ball of 5 µm in diameter. Highest pressure under the tip of the semi-sphere (corresponds to the upper spectra) is about 460 GPa (see fig. S2). Spectra were vertically shifted for clarity.

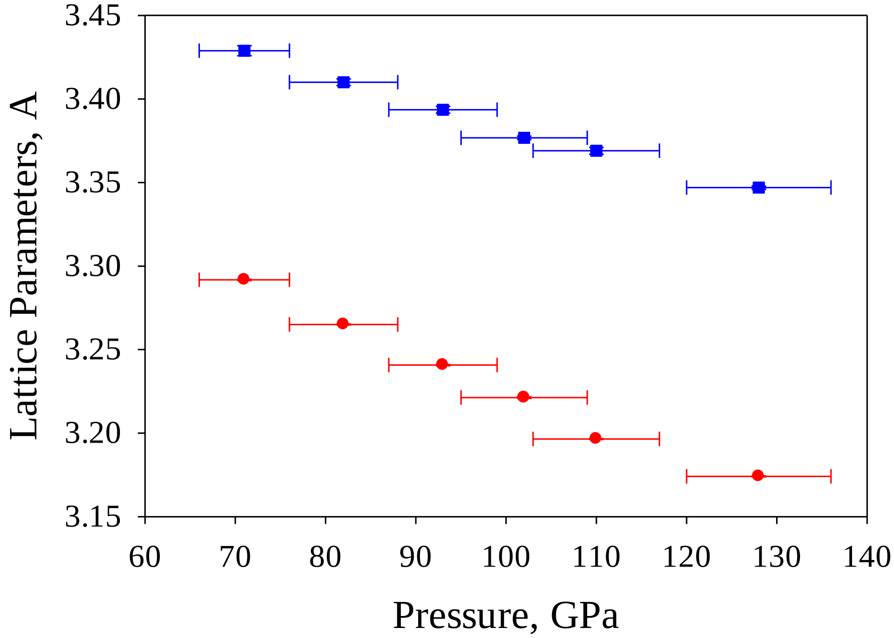

fig. S4. Variations of the lattice parameters of gold (red circles) and NCD of secondary anvils (blue squares) as functions of the pressure in the chamber. The values of pressure in the pressure chamber were estimated from the NCD X-ray diffraction data collected from the points on the side of secondary anvils. The NCD equation of state (*13*) was used. The difference in pressure on NCD and gold simply reflects the principle of pressure multiplication in the double-stage DAC: NCD gives the pressure in the primary chamber, while gold – in the secondary chamber. For example, at a pressure of ~128 GPa in the primary pressure chamber (determined from NCD EOS), the Au EOS for the corresponding unit cell parameter of Au gives the pressure of 1065 GPa in the secondary chamber (between the tips of the semi-balls).

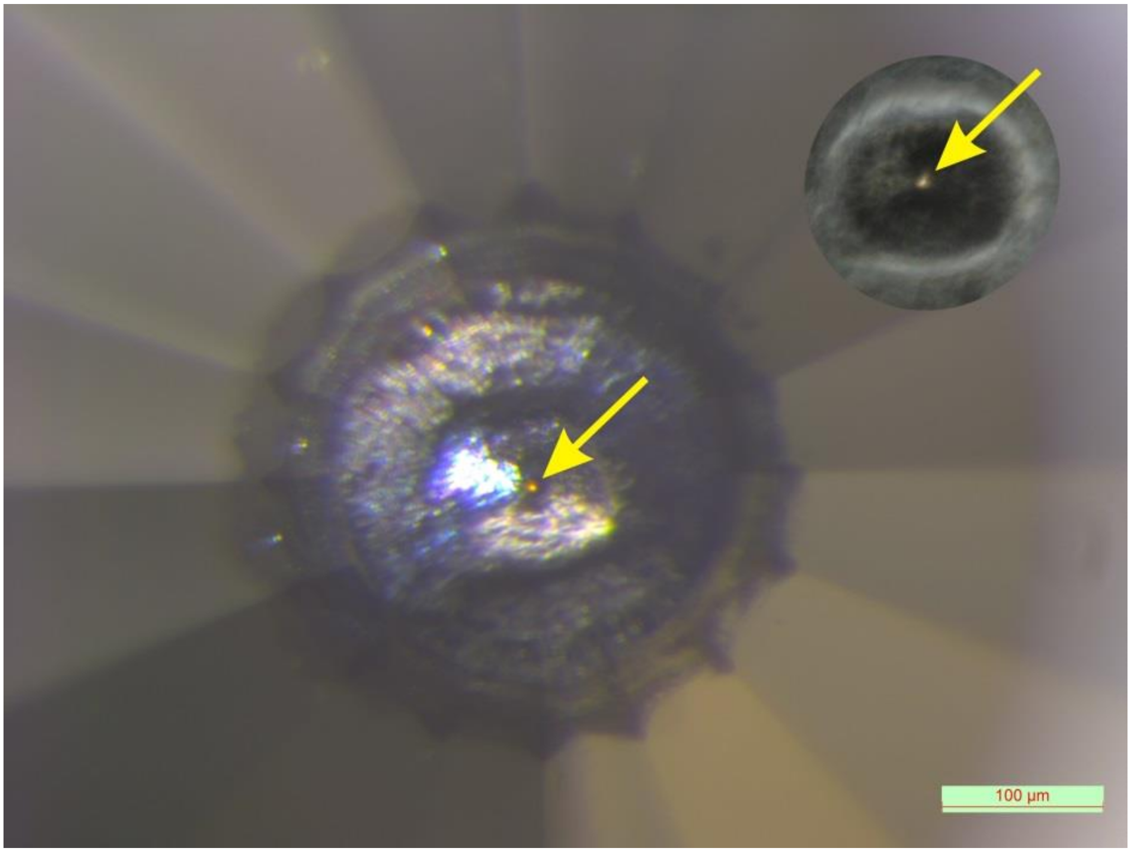

fig. S5. Optical photograph of the sample (Au and paraffin wax) compressed in a gasketed ds-DAC at 688(10) GPa, as seen through the diamonds and NCD secondary anvils. The size of the pressure chamber is of about 5 μm and gold occupies only a portion of it. As a result, one can clearly see the transmitted light (pointed out by the yellow arrow) passing through the material (paraffin wax) that confirms that NCD remains optically transparent even at such high pressures. Insert in the upper right corner shows the central part of the gasket and the pressure chamber under just slight illumination by the reflected light.

Supplementary Table

table S1. Observed and calculated *d* spacing of Au at 1065(15) GPa. (See related Fig. 4B.)

hkl	d_{observed}, Å	$d_{\text{calculated}}$, Å
111	1.8331	1.8326
200	1.5867	1.5870
220	1.1218	1.1222
311	0.9573	0.9570
222	0.9166	0.9163