Electronic Supplementary Material (ESI) for Nanoscale Horizons.

Supplementary Information

High-Pressure Studies of Size Dependent Yield Strength in Rhenium Diboride Nanocrystals

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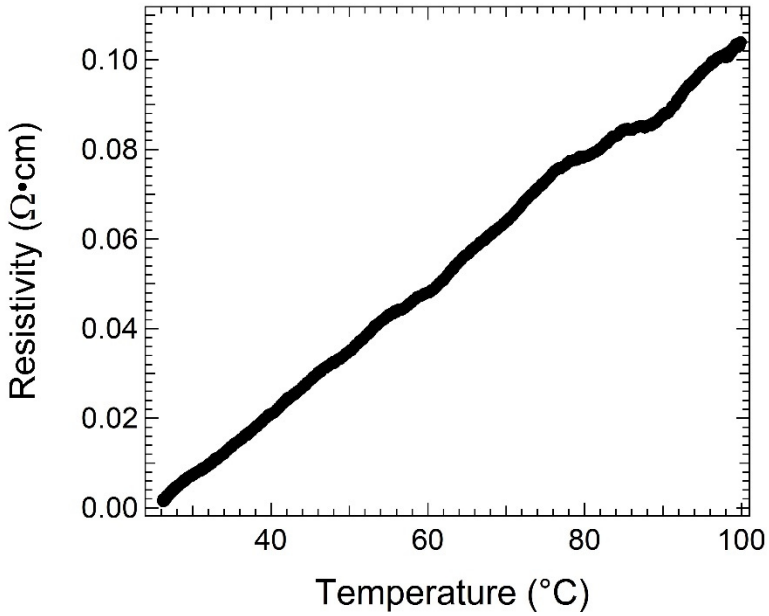

Fig. S1 Two-point resistivity measurements as a function of temperature for nanocrystalline ReB_2. The resistance increases as the temperature rises, indicating that the sample is metallic.

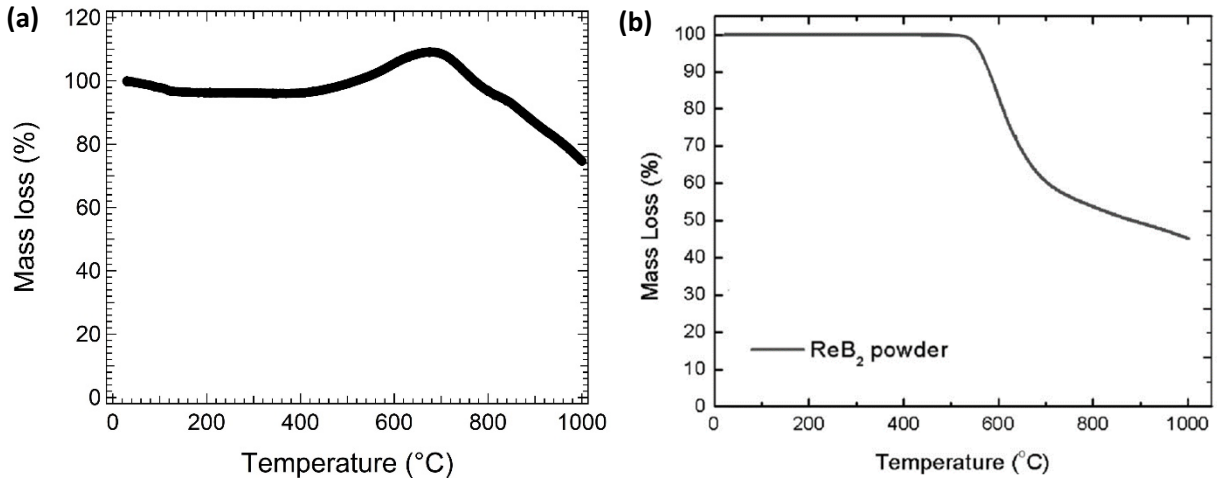

Fig. S2 Thermogravimetric analysis data for (a) nanocrystalline and (b) bulk powder ReB_2.[a] Data were taken under 40 mL/min air flow from room temperature up to 1000 °C at a heating rate of 10 °C/min.

[a]J. B. Levine, S. L. Nguyen, H. I. Rasool, J. A. Wright, S. E. Brown and R. B. Kaner, *J. Am. Chem. Soc.*, 2008, **130**, 16953–16958.

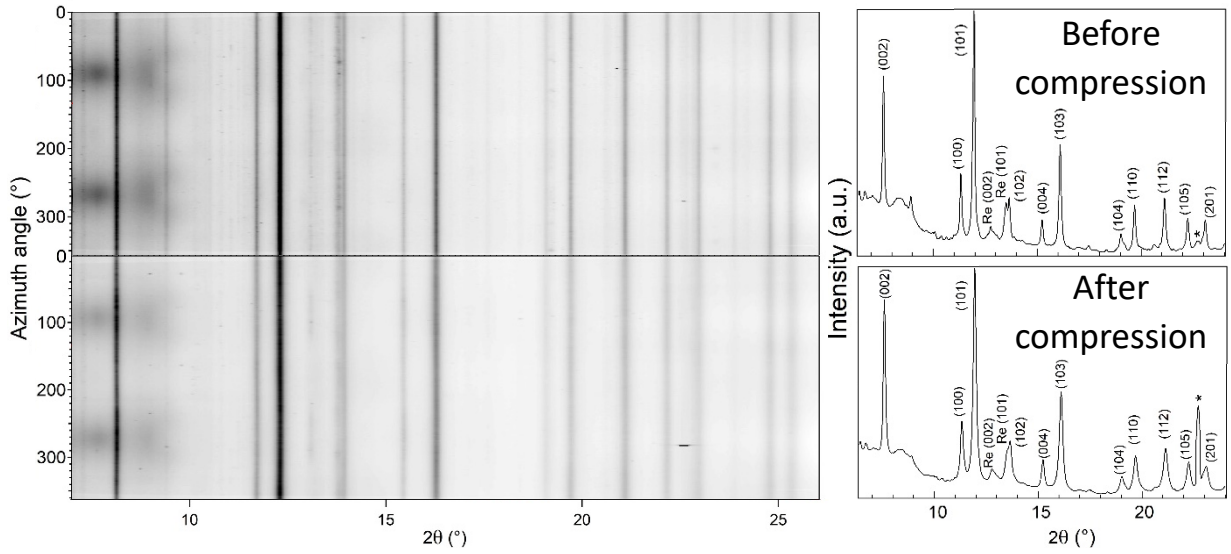

Fig. S3 Synchrotron cake patterns and integrated 1-D X-ray diffraction patterns for 50 nm-ReB_2 nanocrystals at ambient pressure taken before (top) and after (bottom) compression to 59 GPa and decompression back to ambient pressure.

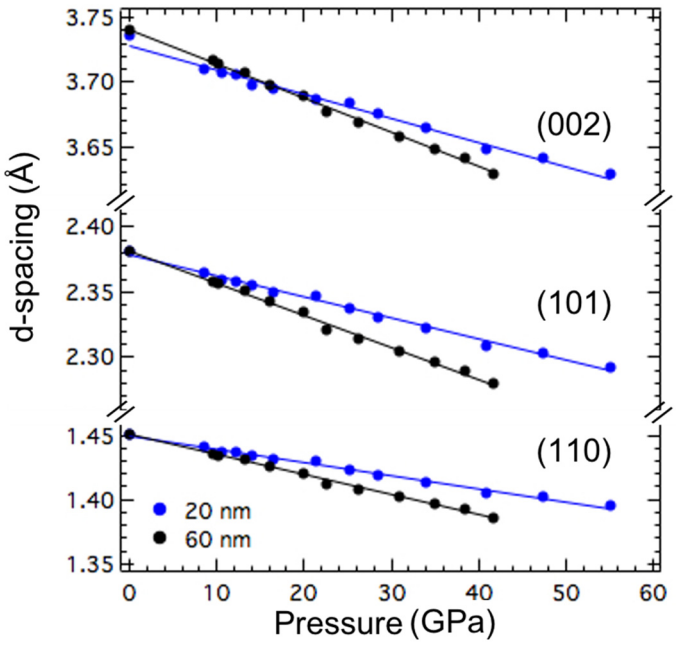

Fig. S4 Measured d-spacings for selected lattice planes of 20 nm- and 60 nm-ReB_2 as a function of pressure.

Table S1. Lattice Parameters as a Function of Pressure for (a) 20 nm- and (b) 60 nm-ReB_2 Nanocrystals

Part a – data for 20 nm nanocrystals		
P (GPa)	a (Å)	c (Å)
55.2(11)	2.7924(9)	7.255(4)
47.4(18)	2.8039(8)	7.281(3)
40.8(10)	2.8113(8)	7.295(3)
34.9(15)	2.8283(7)	7.328(3)
28.5(3)	2.8371(7)	7.351(3)
25.2(10)	2.8470(7)	7.367(3)
21.3(11)	2.8594(10)	7.374(4)
16.5(5)	2.8618(9)	7.390(4)

14.0(5)	2.8694(8)	7.396(4)
12.1(3)	2.8729(8)	7.411(3)
10.5(5)	2.8748(7)	7.415(3)
8.4(4)	2.8819(10)	7.420(4)
0	2.9020(3)	7.473(1)

Part b – data for 60 nm nanocrystals

P (GPa)	a (Å)	c (Å)
41.7(6)	2.7726(8)	7.257(3)
38.4(6)	2.7844(8)	7.281(3)
34.9(6)	2.7938(8)	7.297(3)
30.8(6)	2.8041(8)	7.316(3)
26.2(6)	2.8154(8)	7.336(3)
22.6(8)	2.8250(12)	7.352(5)
19.9(6)	2.8421(8)	7.380(3)
16.1(6)	2.8518(8)	7.397(3)
13.2(7)	2.8627(11)	7.414(4)
10.2(5)	2.8689(7)	7.427(3)
9.5(5)	2.8717(6)	7.433(2)
0	2.9011(1)	7.480(0)

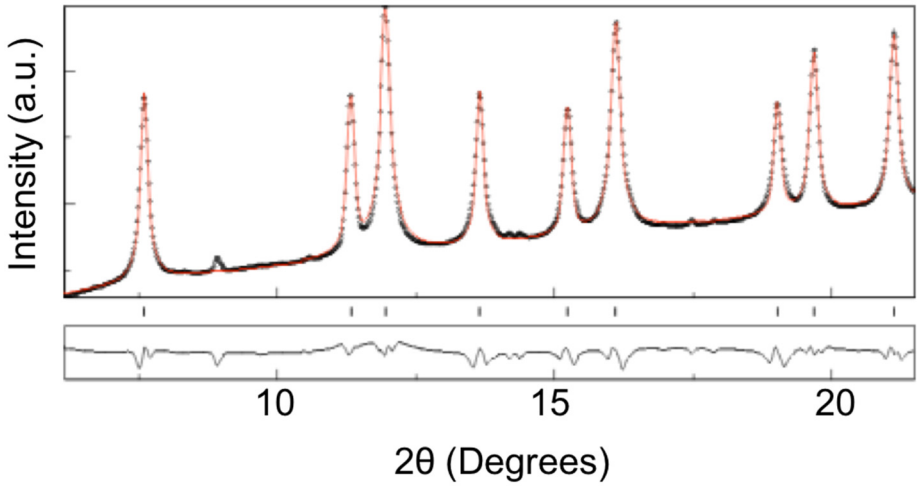

Fig. S5 Rietveld refinement of 60 nm-ReB_2 crystallites at ambient pressure. The experimental data are shown with black symbols and the calculated fit is shown with a solid line in red. The residuals are shown in the small box at the bottom.

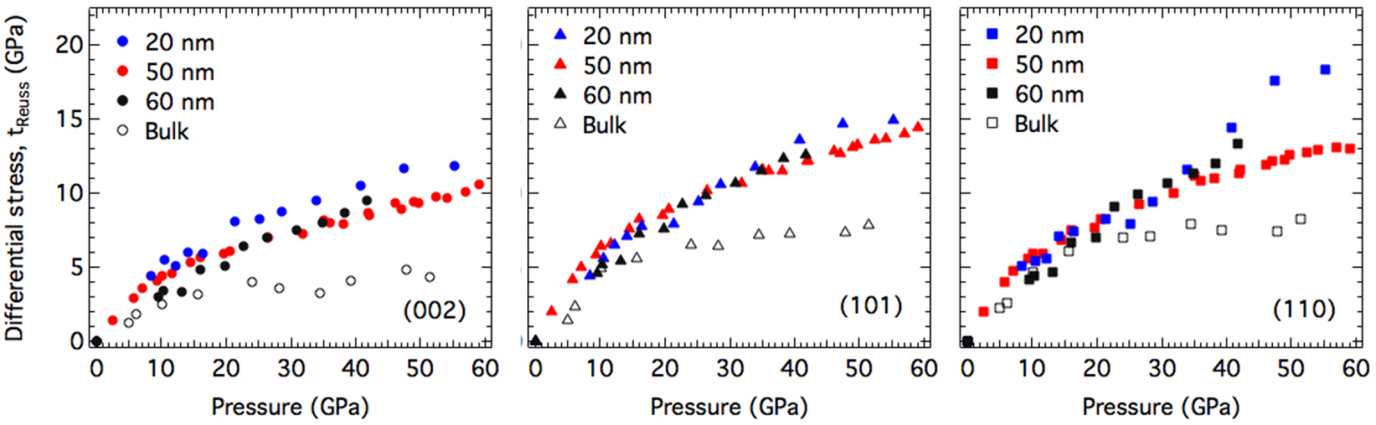

Fig. S6 Differential stress (t) under iso-stress (t_{Reuss}) conditions as a function of pressure for 20 nm-, 50 nm-, 60 nm- and bulk-ReB_2 in the (002), (101) and (110) lattice planes.