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Supporting Information

Individual Boron Nanowire Has Ultra-High Specific Young's Modulus and Fracture Strength as Revealed by *In Situ* Transmission Electron Microscopy

Fei Liu[†, ‡, #, *], Dai-Ming Tang[§, #], Haibo Gan[†], Xiaoshu Mo[†], Jun Chen[†], Shaozhi Deng[†], Ningsheng Xu[†], Yoshio Bando[‡], Dmitri Golberg[£, *]

[†]State Key Laboratory of Optoelectronic Materials and Technologies, Guangdong Province Key Laboratory of Display Material and Technology, and School of Physics and Engineering, Sun Yat-sen University, Guangzhou 510275, PR China

[‡]Inorganic Nanostructured Materials Group, International Center for Materials Nanoarchirectonics (MANA), National Institute for Materials Science (NIMS), Namiki 1-1, Tsukuba, Ibaraki 305-0044 Japan

[§]International Center for Young Scientists (ICYS), National Institute for Materials Science, Namiki 1-1, Tsukuba, Ibaraki 305-0044, Japan

[£]Nanotube Group, International Center for Materials Nanoarchirectonics (MANA), National Institute for Materials Science(NIMS), Namiki 1-1, Tsukuba, Ibaraki 305-0044, Japan

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[*]Corresponding Email: liufei@mail.sysu.edu.cn, GOLBERG.Dmitri@nims.go.jp

[#]These authors contributed equally to this work.

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EELS analysis of an individual BNW in our experiment

Typical EEL spectrum of an individual BNW is provided here to further identify its chemical composition. As observed in Fig. SI, there are only a strong B K-edge and a weaker C K-edge peak existing in the spectrum. Because no any source materials including carbon elements were used in the synthesis reaction, the presence of C is concluded to originate from the carbon grid supporting the sample during the spectrum acquisition. The quantitative analysis reveals that the content of boron in the nanowire is over 95 at.%. So the nanowire in our experiments is thought to be made of nearly pure boron, which coincides with the HRTEM results (Fig. 1D) well.

Comparative table of the known one-dimensional nanomaterial's mechanical properties

To better evaluate the mechanical properties of individual BNWs, we compare the mechanical performance of different one-dimensional nanostructures, as summarized in Table S1. It is seen that the mean Young's modulus and fracture strength of individual BNWs are a little larger than for individual BNWs measured by other two groups [1-2], which should be attributed to higher crystallinity and fewer defect density of the nanowires prepared in our work. It is also found in Table SI that the averaged specific fracture and specific Young's modulus of individual BNW respectively reach 3.9 and 130.6 GPa·cm^3/g, which is close to CNT and Si NWs known for their excellent mechanical behaviors [3-10]. Moreover, the mean Young's modulus of individual BNWs is nearly 4 times higher than that of a GaN nanowire [3, 11], 6-10 times larger than those of ZnO or InN or W NWs [3, 12-18], and 40-130 times larger than that of Au NWs [19-21], which suggests that they are excellent light-weight reinforcing material candidates. Also, it can be observed that the maximum bending stress (36.2 GPa) of individual BNWs is comparable to that of CNT (30-80 GPa) and higher than for Si NWs (5-18 GPa), which also reveals that individual BNWs have a strong endurance to large bending stresses.

Supplement References

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Table and Figure captions

Table S1 Comparative table of one-dimensional nanostructures' mechanical behaviors.

Fig. S1 Representative EEL spectrum of individual BNW.

Sample	Density (g/cm^3)	Maximum strain (%)	Fracture strength (GPa)	Specific fracture strength ($GPa \cdot cm^3/g$)	Young's modulus (GPa)	Specific Young's modulus ($GPa \cdot cm^3/g$)	Maximum bending stress (GPa)
BNW (Our work)	2.36	3.5	9.3	3.9	308.2	130.6	36.2
BNW (SRef. [1])	2.36	/	/	/	150~280	63.6-118.6	/
BNW (SRef. [2])	2.36	1.0-3.0	3.5-8.2	1.5-3.5	250~350	105.9-148.3	/
Si NW (SRef. [3-7])	2.33	4-10	4-15	1.7-6.4	100~180	42.9-77.3	5-18
CNT (SRef. [8-10])	1.5	12	10-30	7-40	300~1000	200-666.7	/
GaN NW (SRef. [3, 11])	6.15	/	/	/	220~300	35.8-48.8	/
ZnO NW (SRef. [12-15])	5.61	3-5	1-7	0.2-1.2	90~150	16.0-26.7	4-10
InN NW (SRef. [3, 16])	6.81	/	/	/	120~200	16.6-29.4	/
W NW (SRef. [3, 17, 18])	19.25	/	/	/	320~380	16.6-19.7	/
Au NW (SRef. [19-21])	19.3	2-5	2-5	0.1-0.3	15~60	0.8-3.1	/

Table S1

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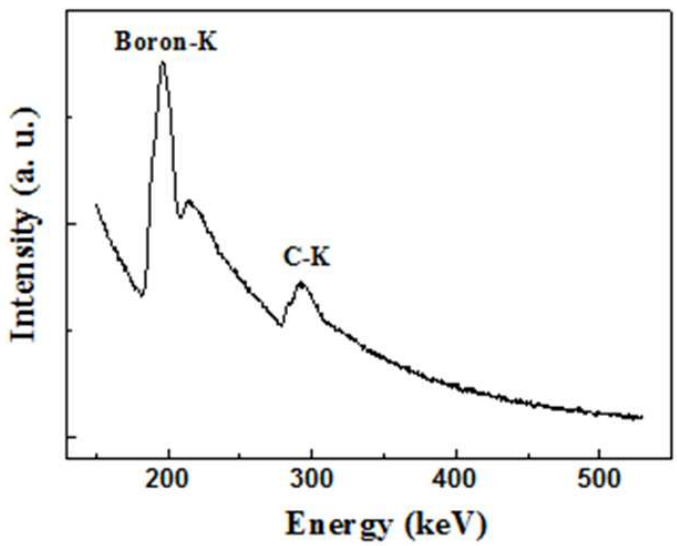

Figure S1

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