Supporting Information

Mechanical Properties and a Brittle-to-Ductile Fracture Transition in 3D Boron Nitride Foams

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I. Experimental Setup

We clamped the synthesized rectangular BNF samples (shown in Figure S1a) on both ends to the tensile instrument, such that $\sim 1\ cm$ in the middle of the sample was exposed and subjected to tension, see Figure S1b, Figure S1c, and Figure S1d.

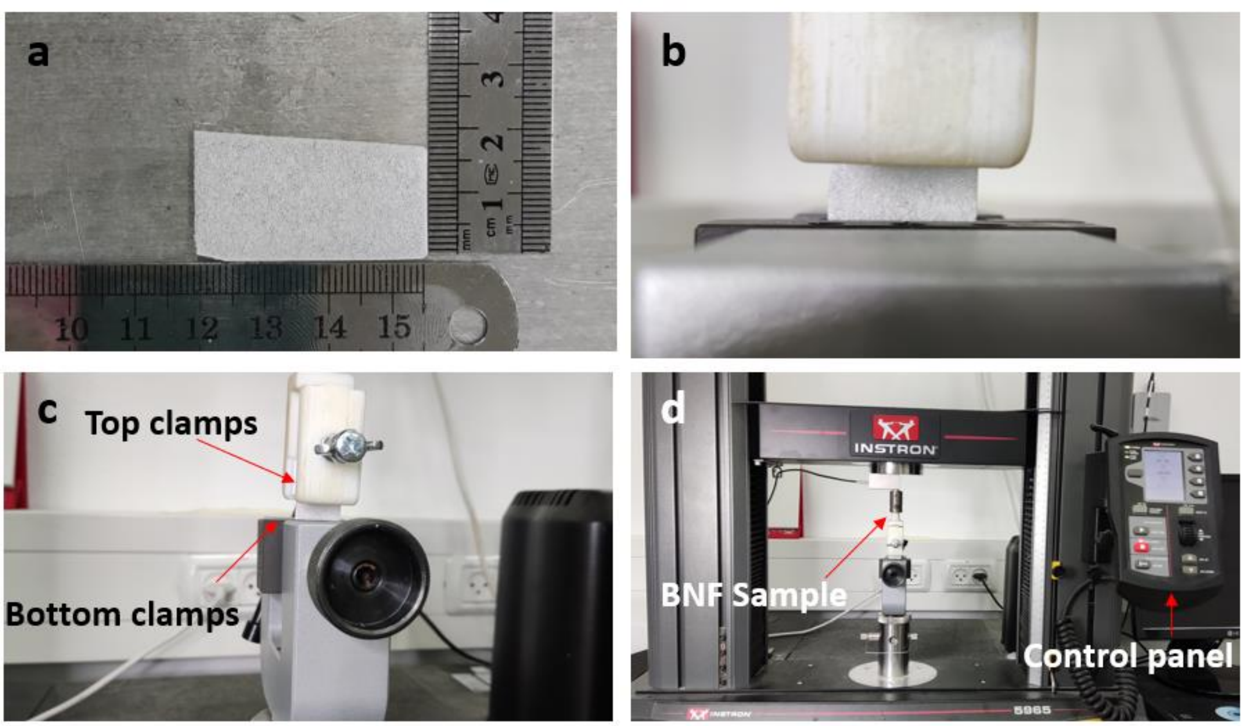

Figure S1. Experimental setup. (a) BNF sample. (b, c, d) Clamped BNF sample in the tensile instrument.

II. Additional force-deflection measurements

We investigated several BNF samples. The force-deflection curves of 4 samples are shown in Figure S2. The horizontal and vertical displacement and strain fields of another strain sample subjected to a tensile strain of $\varepsilon_y = 0.729 \times 10^{-3}$ is shown in Figure S3.

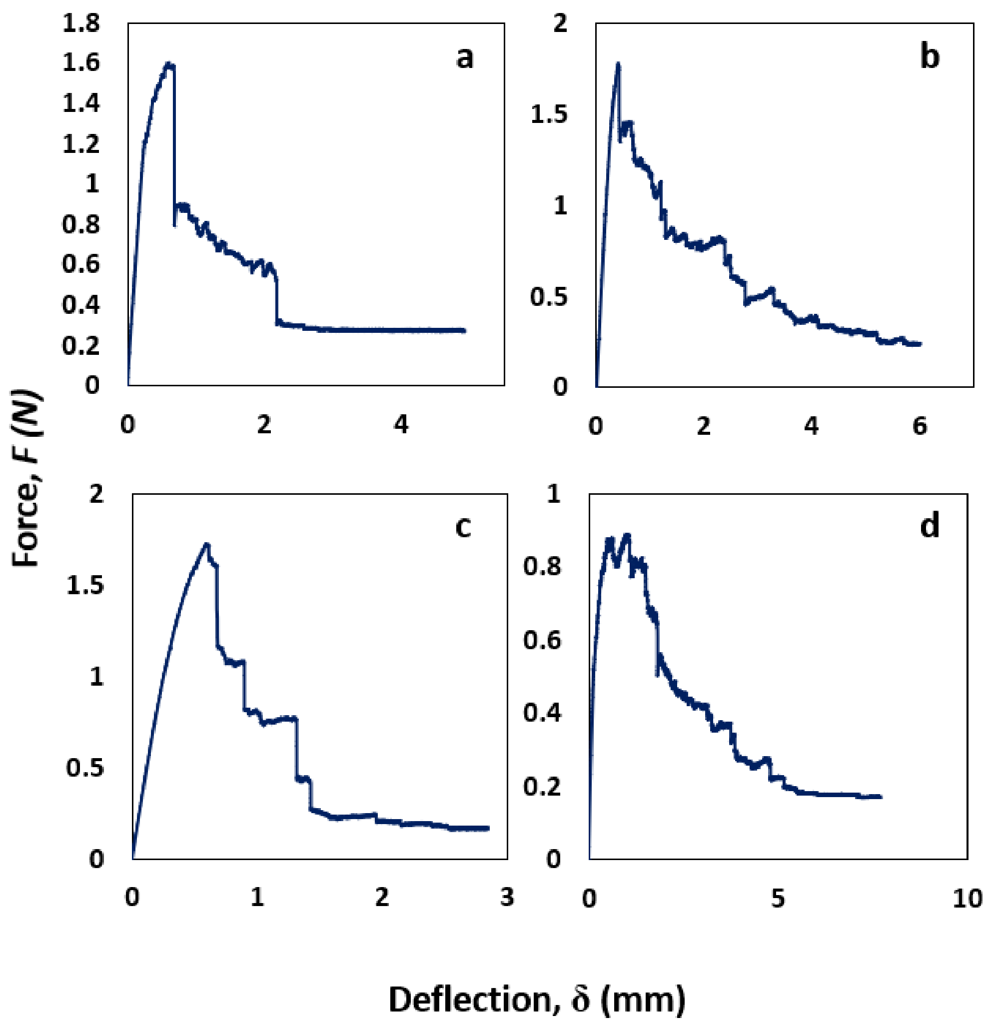

Figure S2. Force-deflection curves of several BNF samples. Each figure corresponds to a different sample.

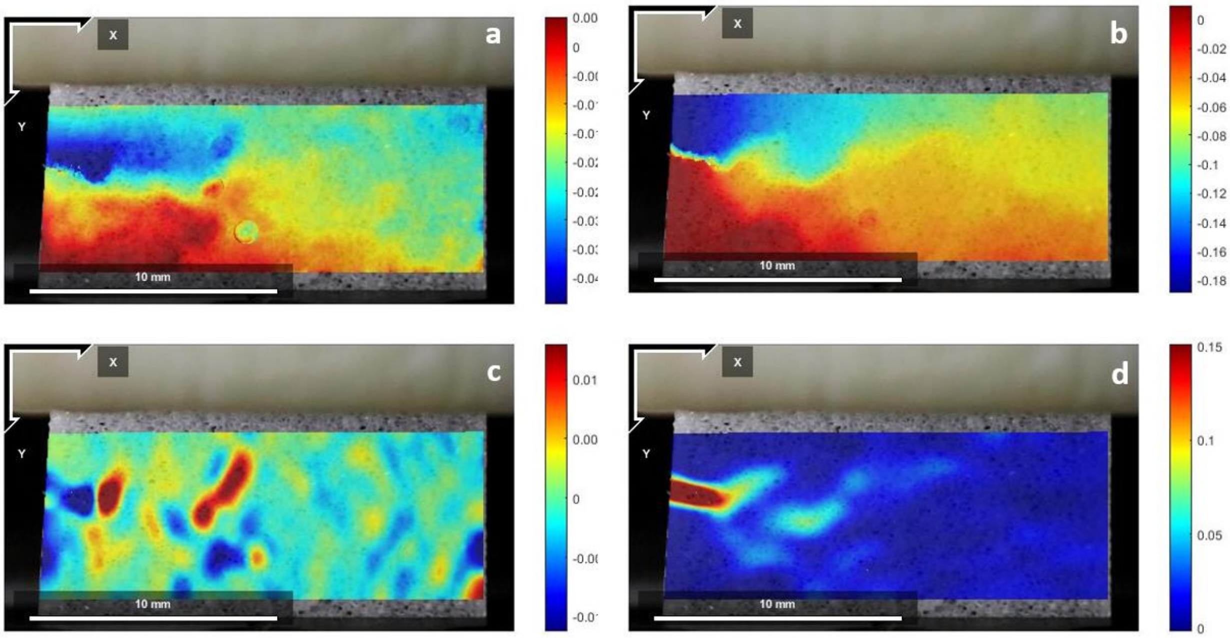

Figure S3. DIC analysis of sample subjected to a tensile strain of $\varepsilon_y = 0.729 \times 10^{-3}$ (a) Displacement field in the horizontal u direction. (b) Displacement field in the vertical v direction. (c) Horizontal strain field ε_x. (d) Vertical strain field ε_y.

III. Additional SEM images

We show here additional SEM images of our fractured samples. In Figure S4 we present several images of ductile fractures with cavities. In Figure S5 we present open (fractured) branches that experienced a ductile fracture. Finally, in Figure S6 we show images of brittle fractures.

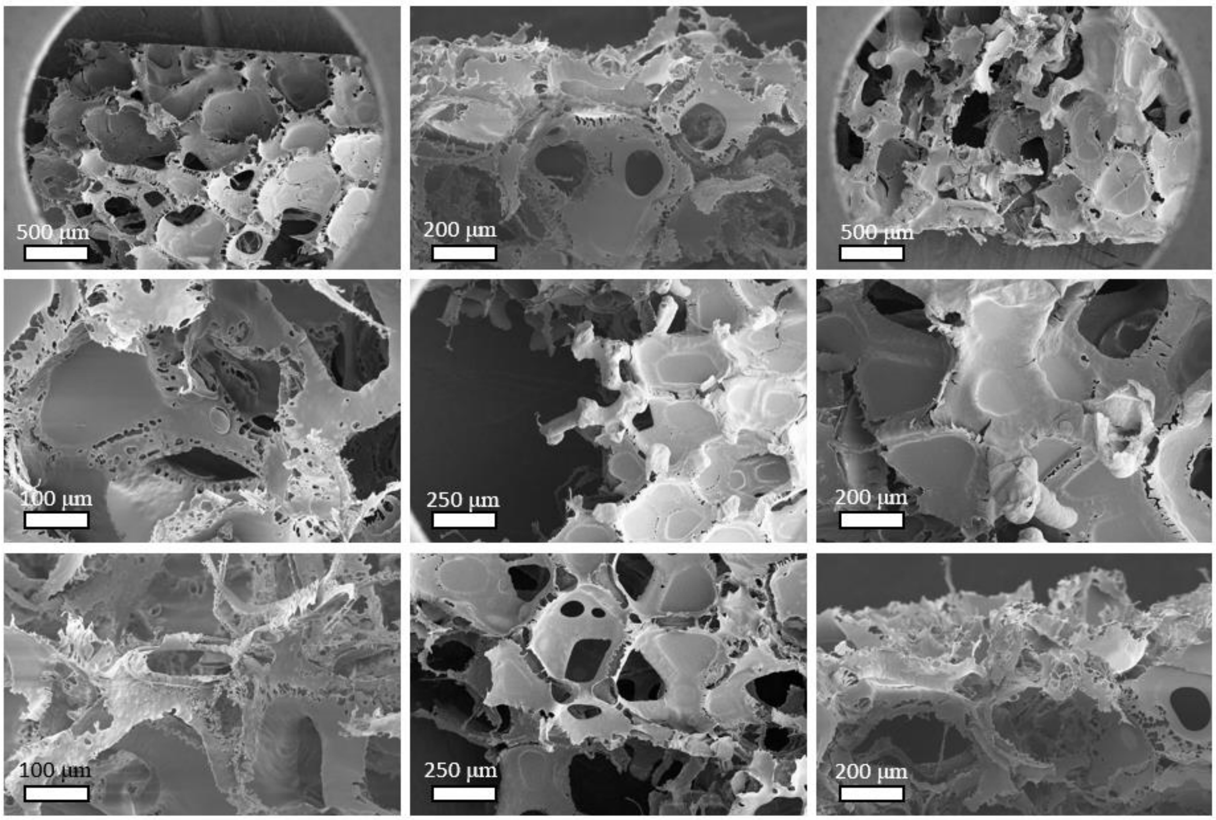

Figure S4. SEM images of ductile fracture.

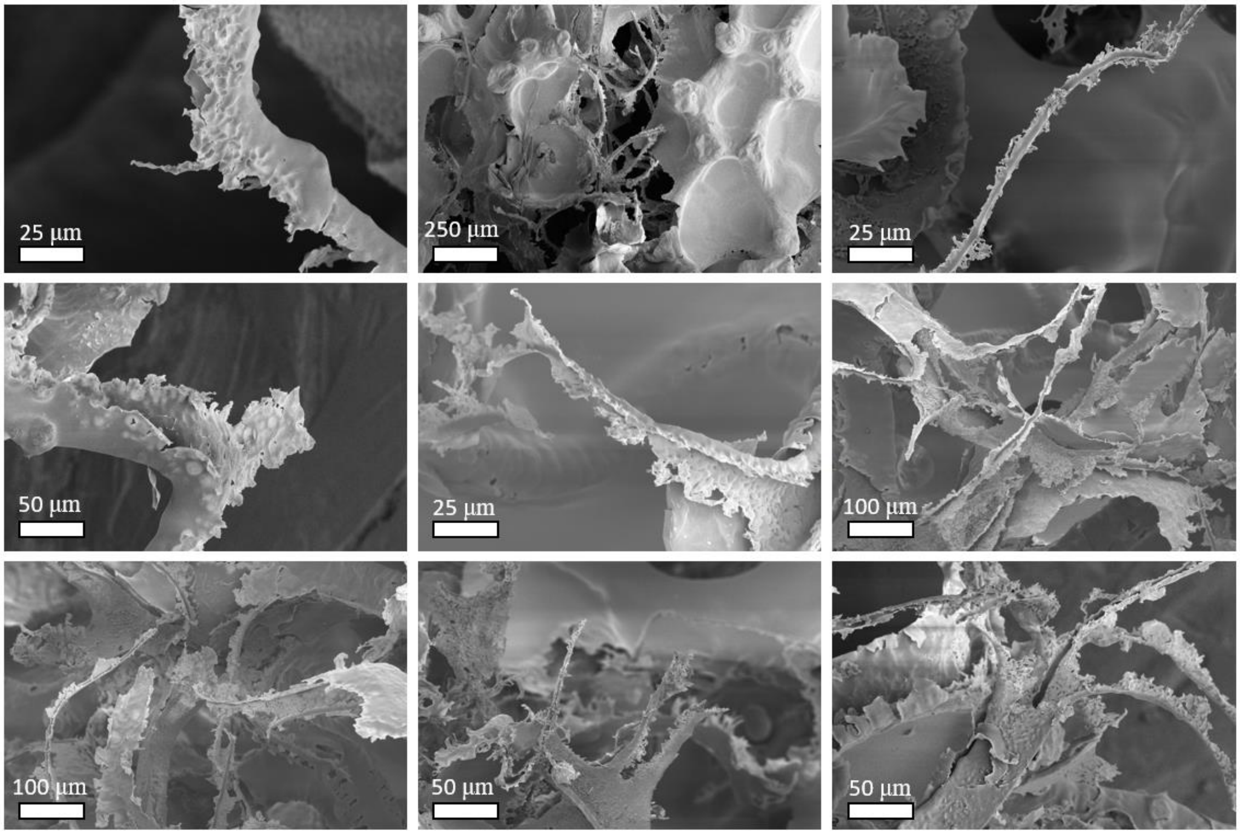

Figure S5. SEM images of open branches that experienced a ductile fracture.

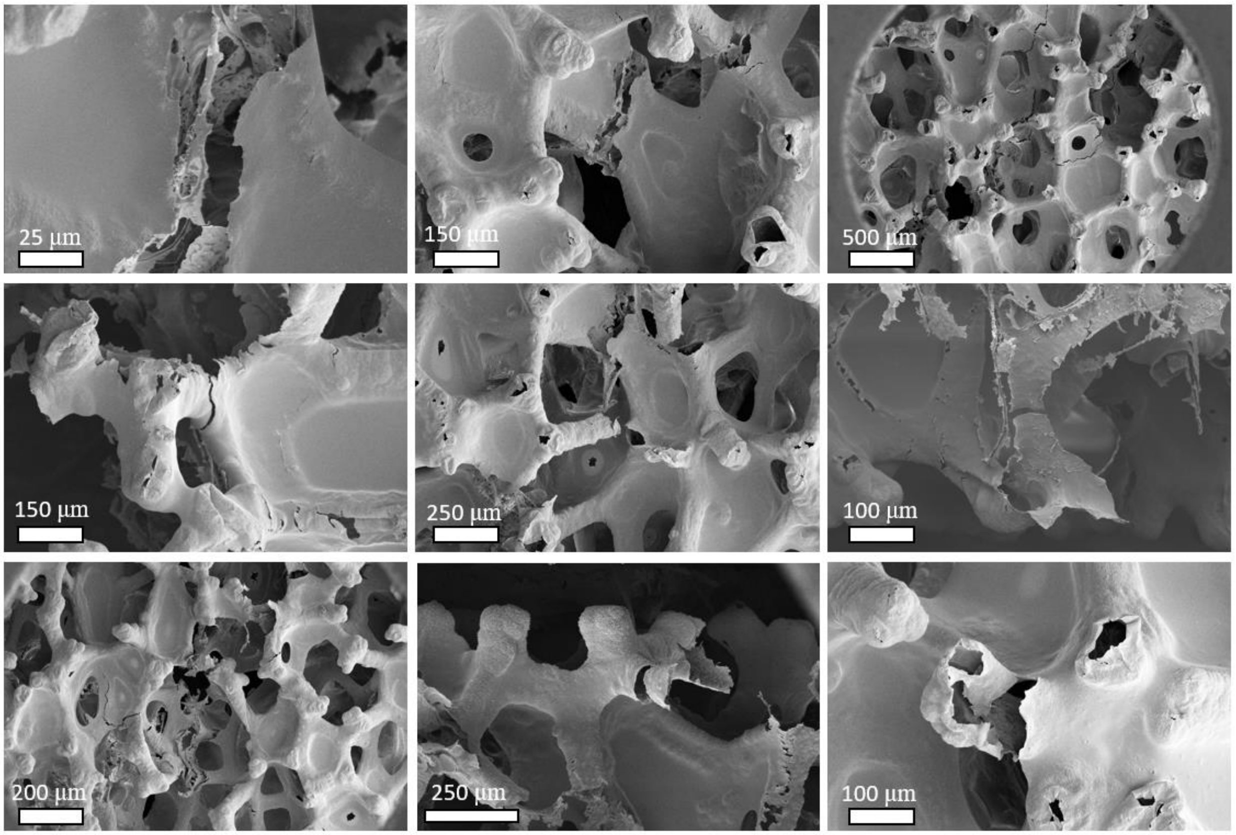

Figure S6. SEM images of brittle fractures in BNF samples.

IV. Additional TEM thickness measurements

To measure the thickness of BNF samples, we first crumbled a small amount of a sample on a clean surface. We then rubbed the TEM grid on the surface, collecting the small fragments of the BNF on the grid. We show in Figure S7 the thinnest and thickness measured BN walls.

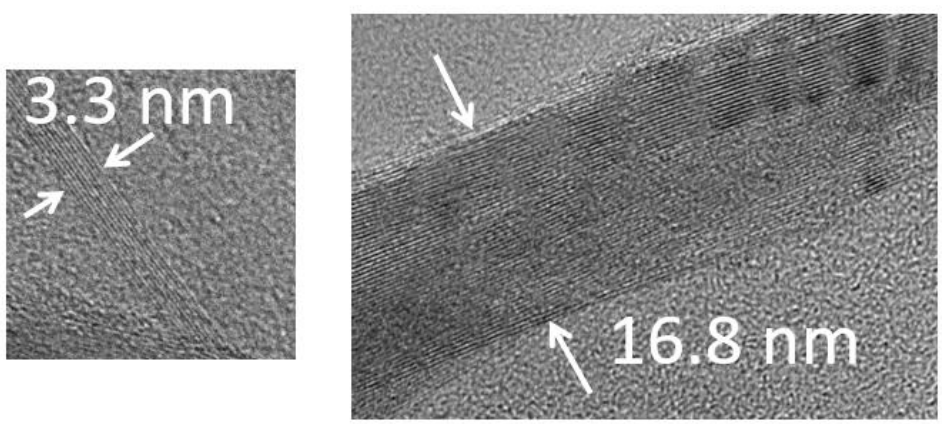

Figure S7. TEM images of 3.3 *nm* and 16.8 *nm* thick BN walls.

V. FEM simulation details

FEM calculations were conducted using COMSOL Multiphysics software. We conducted both 3D and 2D analyses using a solid mechanics solver. First, in the 3D simulations, we roughly evaluated the stress along the BN branch and its deformed shape (Figure 4a in the main text). Then, to refine our stress analysis we also conducted 2D simulations (inset of Figure 4b in the main text). In the 2D simulations, we constrained the BN to a smaller diameter (as indicated by the 3D analysis) and extracted the induced stress for different thicknesses. Notably, these 2D simulations enabled us to apply a fine mesh to the BN walls that lead to a more accurate numerical evaluation of the stress across the width of the walls.