ADVANCED FUNCTIONAL MATERIALS

Supporting Information

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Scaling the Stiffness, Strength, and Toughness of Ceramic-Coated Nanotube Foams into the Structural Regime

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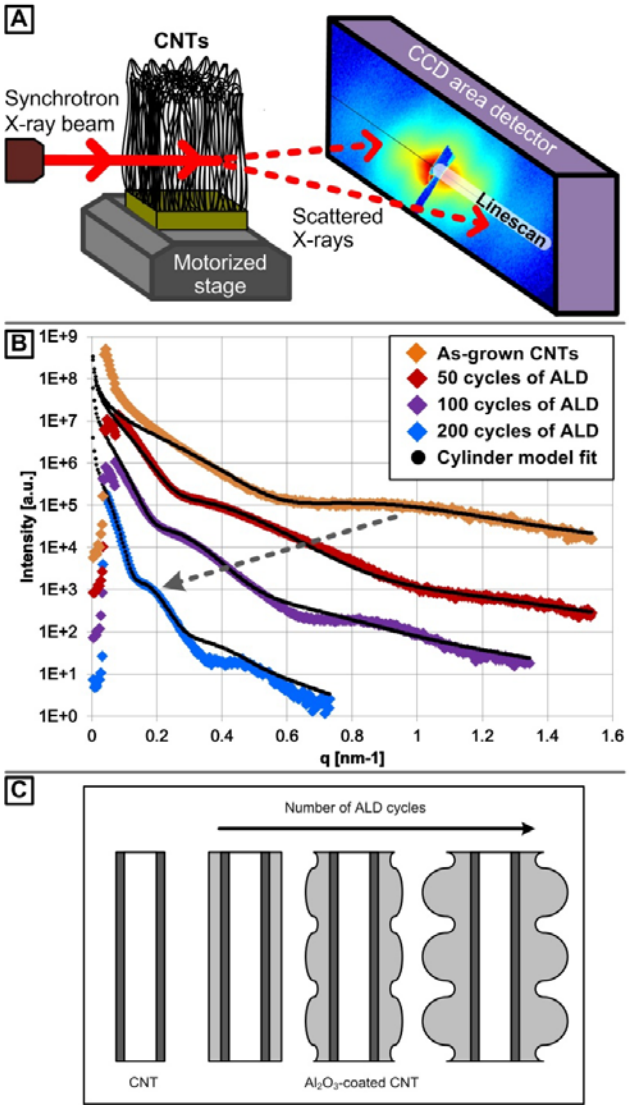

Fig. S1: SAXS characterization of Al_2O_3 coating thickness evolution. (a) Schematic of experimental setup for high energy transmission SAXS of vertically aligned CNT; (b) Line scans of scattering spectra having various number of ALD cycles, where arrow indicates the decrease in q with the increased number of cycles in addition to the appearance of a new peak at high q values; and (c) schematics qualitatively showing the evolution of the film thickness as well as the surface roughness of the CNT-Al_2O_3 nanotubes.

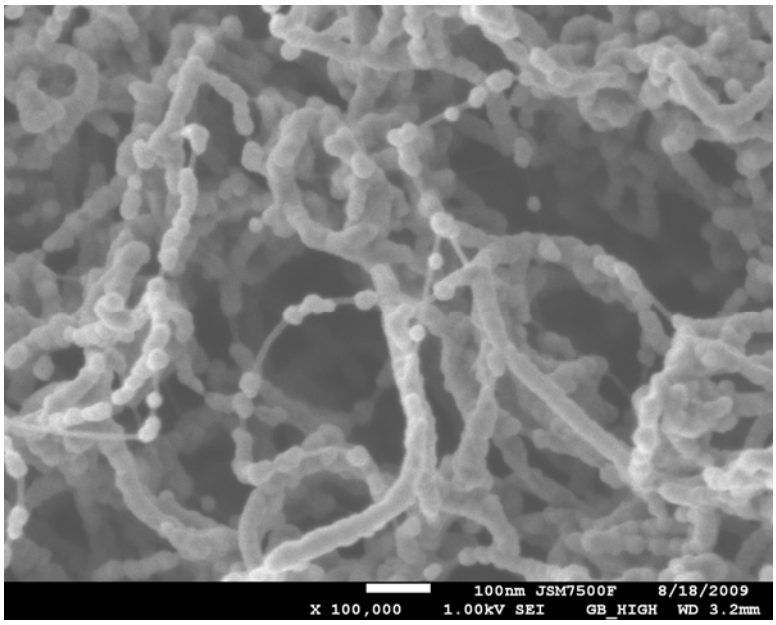

Fig. S2: High-resolution SEM image of top of CNT forest coated with 100 cycles Al_2O_3 by ALD.

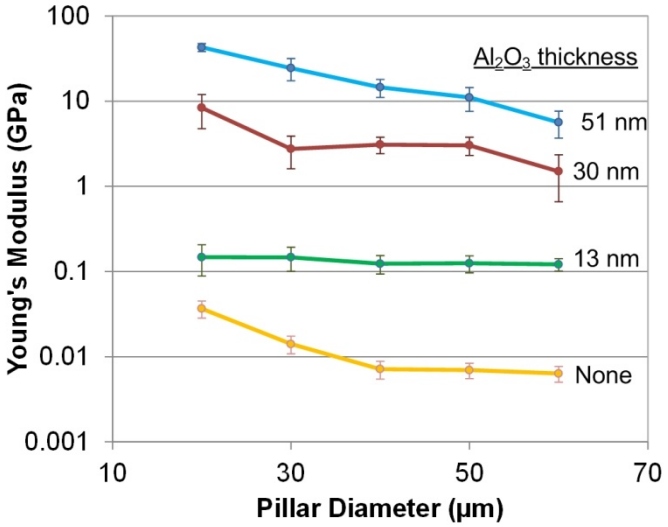

Fig. S3: Measured Young's modulus (in compression) as versus micropillar diameter for bare CNTs, and CNTs coated with 13, 30, and 51 nm Al_2O_3 by ALD.

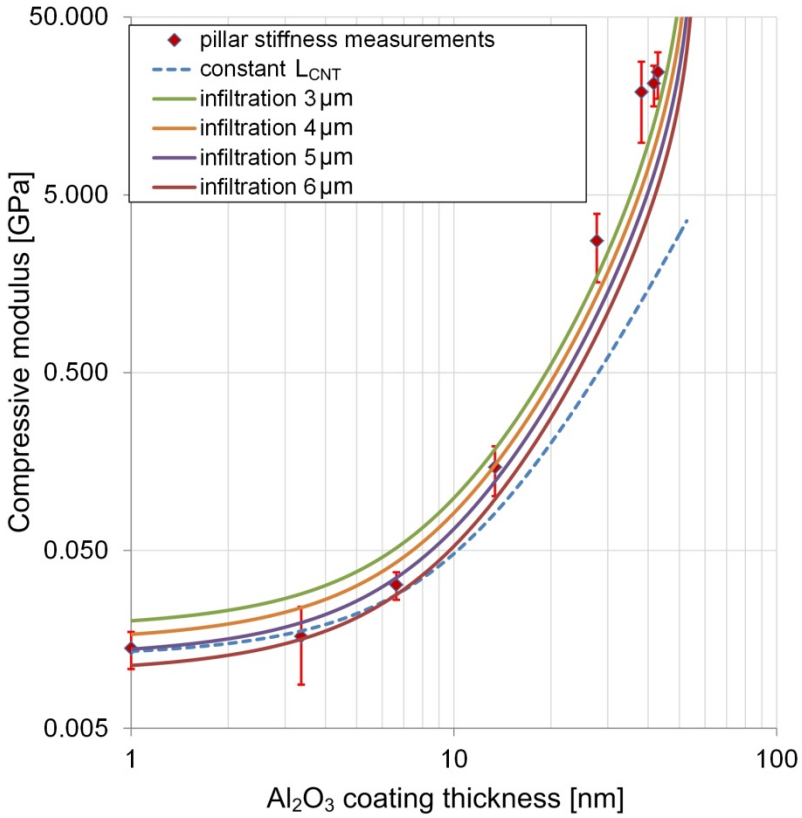

Fig. S4: Plot showing the sensitivity of the model, used to predict Young's modulus, to the penetration depth of the ALD coating (hence changing the coated volume of the micropillar).

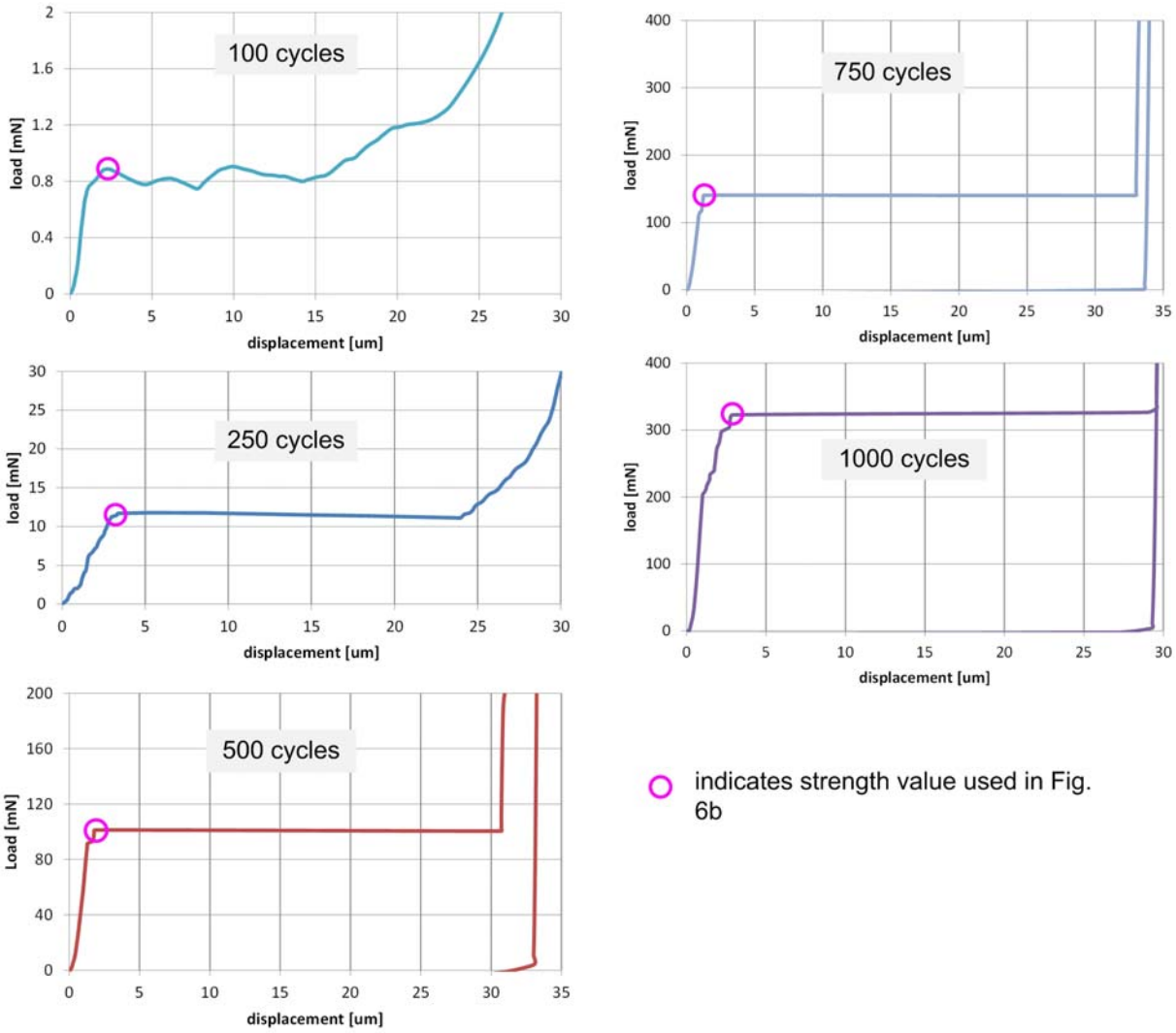

Fig. S5: Load-displacement curves for Al_2O_3/CNT micropillars, with number of ALD cycles as noted. The circle superimposed on each curve indicates the strength value used to construct the strength-density relationship in Fig. 6.