Supporting Information

Fitting procedure and parameters

We fit the experimental resistance data using Ohm's law by slicing the geometric model into pixel-thick circular cross sections of uniform inner and outer diameter. The resistance is then calculated from the sum:

$$\int \frac{\rho}{A} dL + R_0 \approx \rho \sum_i \frac{\Delta L}{A_i} + R_0 \qquad (1)$$

where ρ is the bulk resistivity, R_0 is the contact resistance, A_i is the cross sectional area of each slice and ΔL is the length associated with a single pixel (0.054 nm). This approximation is accurate for a hollow tube with constant diameter (strictly speaking there is a small error of order 5% introduced in the regions in which the diameter is changing [28], but this does not significantly alter the total resistance values).

We obtain an excellent fit to the measured high temperature resistances with bulk resistivity $\rho = 3.8 \cdot 10^{-6}$ Ω·m and contact resistance $R_0 = 6.1$ kΩ. (The calculated contact resistance includes the lengths of nanotube leading from the metal contacts to the region of interest shown in Figure 1. Subtracting the resistance of these lengths (calculated from the fitted resistivity) yields a total metal-nanotube contact resistance $R_0 = 1.3$ kΩ.) The calculated resistivity agrees well with high temperature measurements of the basal plane resistivity of pyrolytic graphite, on the order of 10^{-6} Ω·m at 1200K [29-31]. A similar fit to the low current, room temperature data yields $\rho = 1.0 \cdot 10^{-5}$ Ω·m

Calculated and measured high temperature resistance values for the diameter-selected CNTs are shown in Figure 3. To evaluate the fit we calculate the coefficient of determination:

$$r^2 = \frac{\sum_i (R_i - \bar{R})^2 - \sum_i (R_i - \hat{R}_i)^2}{\sum_i (R_i - \bar{R})^2} \qquad (2)$$

where R_i is a calculated value, $\hat{R}_i$ is the corresponding measured value, and $\bar{R}$ is the arithmetic mean of the calculated values. Correlation of measured and calculated resistances yields a coefficient of determination $r^2 = 0.989$, indicating an excellent fit. The data acquired as the nanotube diameter gets very small deviate from the fit due to the high sensitivity of the calculation to pixel-sized effects at these small diameters. If the last point in Figure 3 is excluded, r^2 increases to 0.995. This excellent fit allows us to invert the calculation and predict the diameter of the reformed nanotube from the resistance of the device, as shown in the inset of Figure 3.