Supporting Information

Garaj et al. 10.1073/pnas.1220012110

SI Text

Derivation of Eq. 1

To avoid double subscripts and enhance legibility, the term used to indicate the polymer diameter in the main text, d_{poly}, is replaced here by d without any subscript.

Eq. **1** is derived by defining the difference between the pore and the molecule diameter as

$$\delta = D - d.$$

Recognizing that

$$\Delta I_B = I_0(D) - I_B(D,d) = \Delta I_B(D,d),$$

it must be true that

$$\Delta I_B(D, D-\delta) = \Delta I_B(d+\delta, d).$$

Taylor expand both sides of this equation around $\delta = 0$ to first order in δ to obtain

$$\Delta I_B(D,D) + \left.\frac{\partial \Delta I_B}{\partial d}\right|_{d=D-\delta} \cdot (-\delta) = \Delta I_B(d,d) + \left.\frac{\partial \Delta I_B}{\partial D}\right|_{D=d+\delta} \cdot (\delta).$$

Noting that $I_B(D,D) = 0$, $I_B(d,d) = 0$ yields

$$\left.\frac{\partial \Delta I_B}{\partial d}\right|_{d=D-\delta} = -\left.\frac{\partial \Delta I_B}{\partial D}\right|_{D=d+\delta} + \frac{I_0(D) - I_0(d)}{\delta}.$$

However, $I_0(d) = I_0(D-\delta)$, which when expanded yields for small δ

$$\left.\frac{\partial \Delta I_B}{\partial d}\right|_{d=D} = -\left.\frac{\partial \Delta I_B}{\partial D}\right|_{D=d} + \frac{dI_0}{dD},$$

which is given in Eq. **1** in the main text. Note that for a short nanopore $I_0(D) \propto D$ and therefore the last term in the above equation is a constant. Its value, 3.85 nA/nm, is approximated by the slope of the dotted line in Fig. 1*B*.

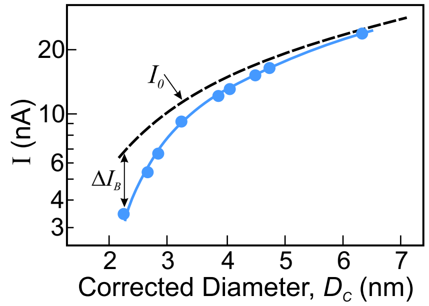

Fig. S1. Current through open nanopores or nanopores during double-stranded (ds)DNA translocation. Solid blue circles show the observed currents during DNA translocation; dashed curve shows the calculated open pore current through graphene nanopores. The pore diameters shown here are the corrected nanopore diameters, as explained in *Modeling* in the main text.

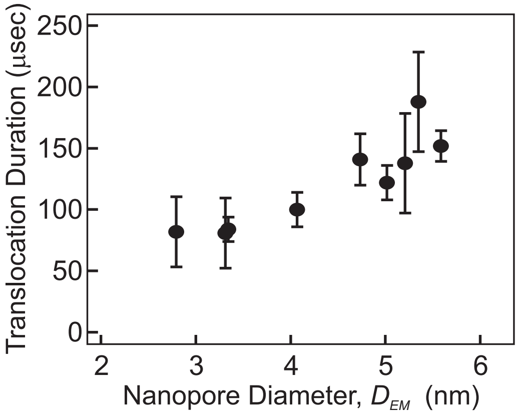

Fig. S2. Time duration for dsDNA to translocate through graphene nanopores. The solid circles and associated lines indicate the average blockade duration and full width at half maximum of all of the measured blockade durations for 10 kb dsDNA to translocate through nanopores of differing diameters.

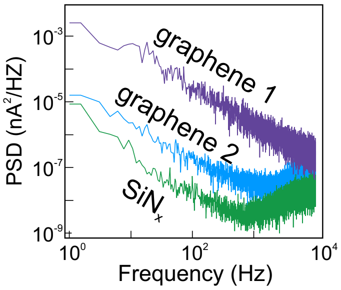

Fig. S3. Noise power spectral densities for three typical nanopores. Graphene 1, a 5-nm diameter nanopore in single-layer graphene suspended across a 200 × 200-nm SiN_x aperture; graphene 2, a 5-nm diameter graphene nanopore across a 20-nm diameter SiN_x aperture showing greatly reduced noise; SiN_x, a 5-nm diameter nanopore in SiN_x with no graphene.

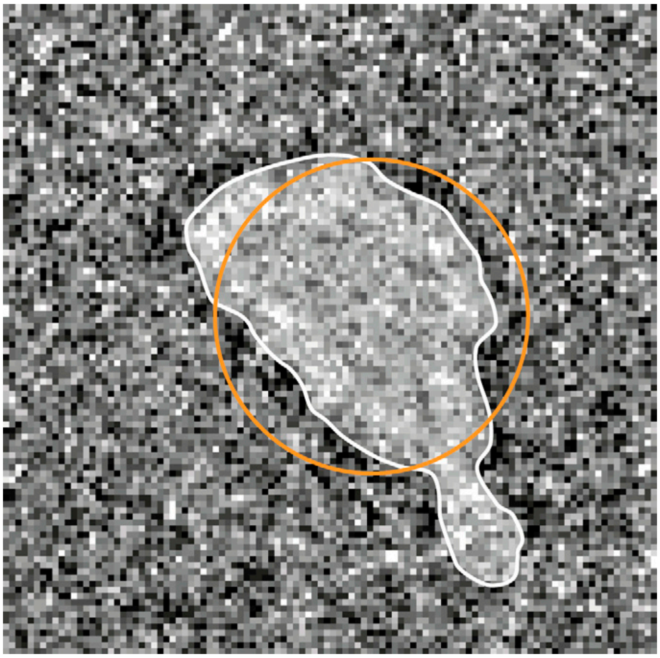

Fig. S4. Estimating D_{EM}. To estimate the diameters of nanopores that, as illustrated here, may be far from perfectly circular, the outline of the nanopore's EM image was manually traced (white line). D_{EM} was then calculated as twice the radius of a perfect circle (orange circle) whose area was equal to the sum of all of the pixel areas enclosed within the manually traced pore outline (white line). For clarity, the white coloration of all pixels enclosed within the manually traced nanopore has been computer enhanced.