

Supporting Information for

Gold Nanorod Translocations and Charge Measurement through Solid-State Nanopores

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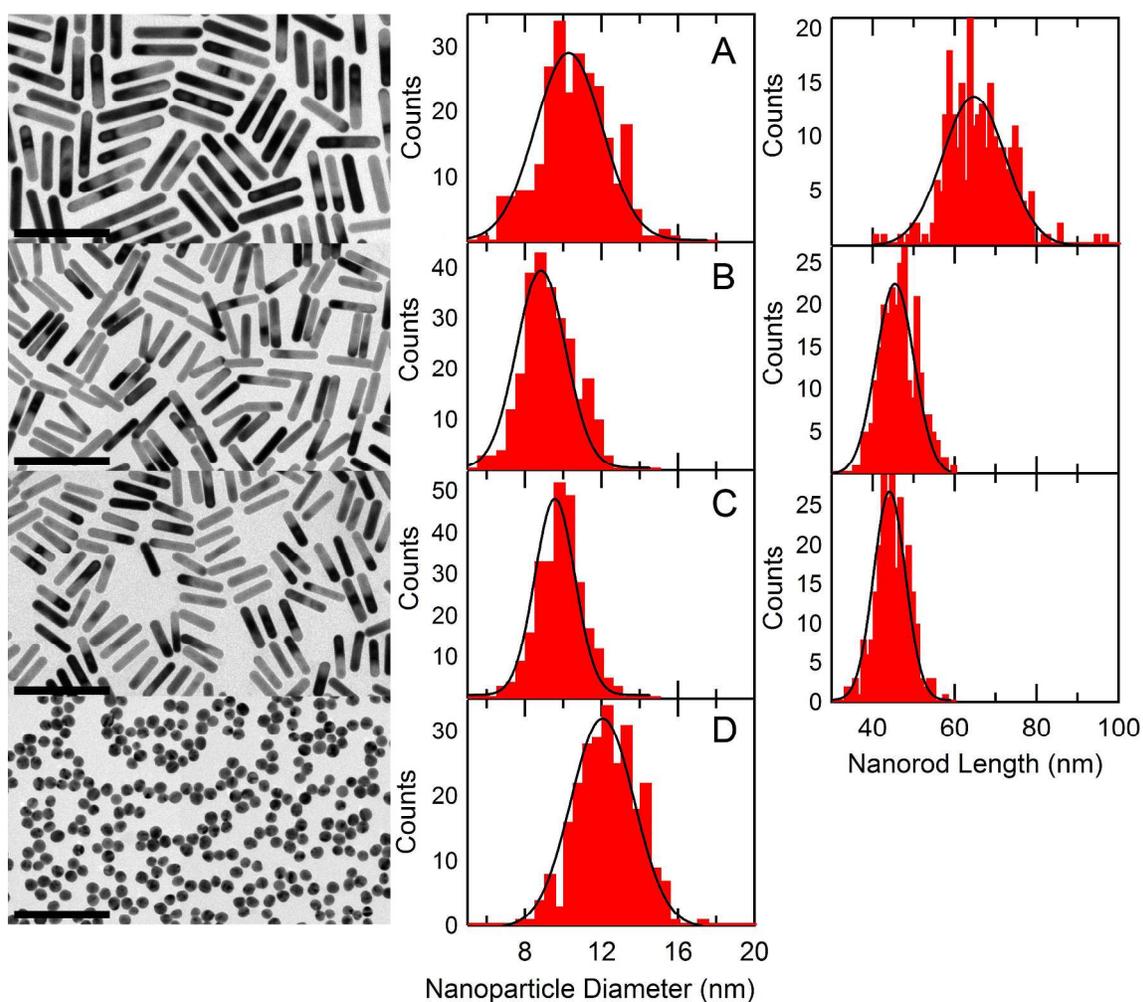


FIGURE S1 Analysis of nanoparticle dimensions. Nanorod and nanoparticle dimensions were measured from TEM images. Scale bar is 100 nm. At least 250 data points were acquired to create each histogram. The first column shows an example of a TEM image for each sample, the second column shows histograms of the diameters for each sample, and the third column shows histograms of the lengths for each sample. The first row is data for sample A, the second row is data for sample B, the third row is data for sample C, and the last row is data for the spherical sample D. From these histograms, we acquired values of nanoparticle diameters and lengths displayed in the table below and used in this work.

| Sample | Nanoparticle Diameter (nm) | Nanorod Length (nm) |
|--------|----------------------------|---------------------|
| A | 10 ± 2 | 65 ± 11 |
| B | 9 ± 2 | 45 ± 7 |
| C | 10 ± 1 | 44 ± 6 |
| D | 12 ± 2 | |

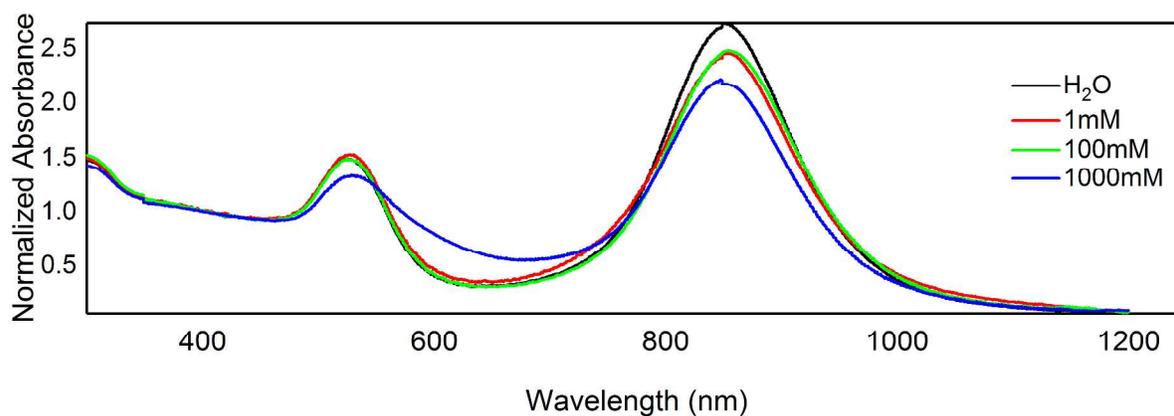


FIGURE S2 Absorbance of 9 nm diameter, 45 nm long nanorods (sample B) normalized to the absorbance at 400 nm wavelength, and measured at varying salt concentrations. There is no noticeable broadening or red-shifting of the nanorod absorbance peaks at 100 mM KCl solution, indicating that minimal aggregation occurs.

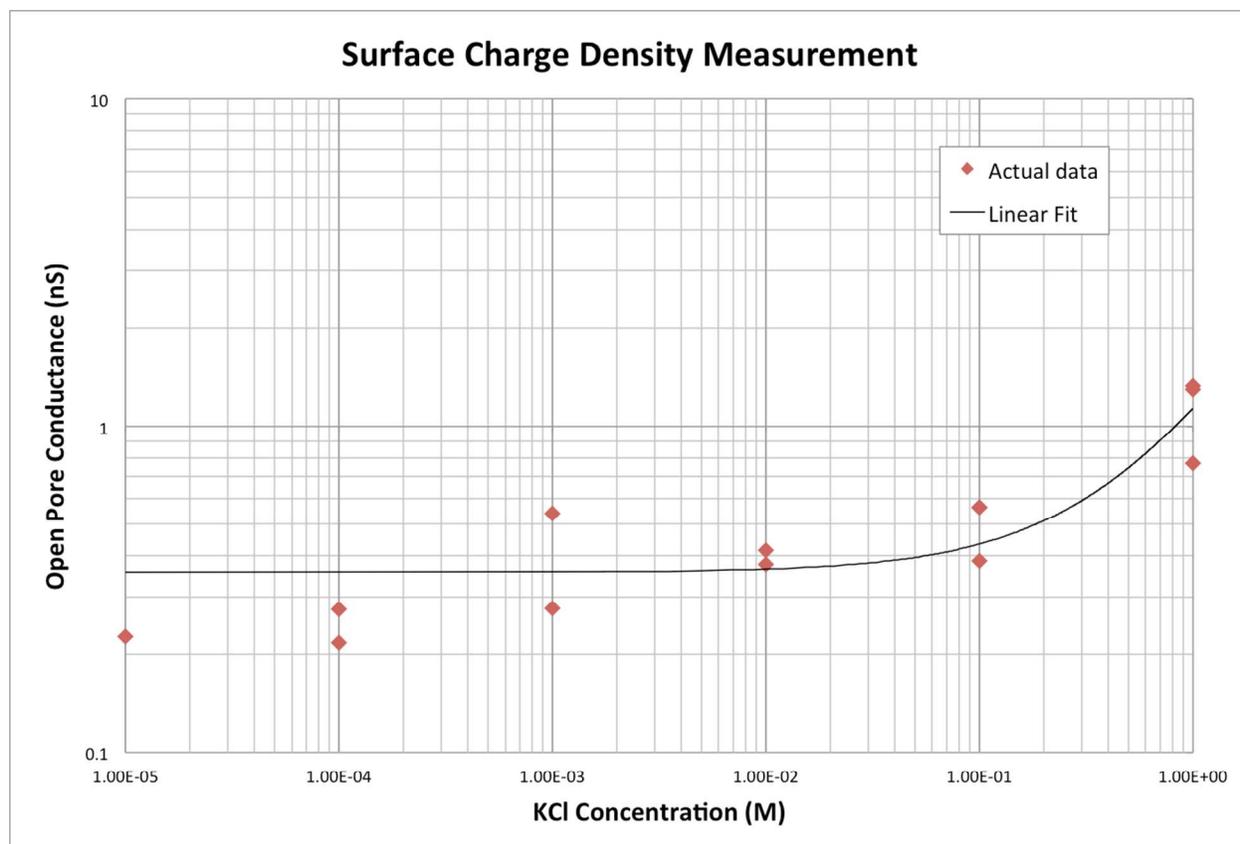


FIGURE S3 Measurement of nanopore surface charge. The conductance of an 5-nm-diameter and 85-nm-thick piranha cleaned Si_3N_4 nanopore was measured in salt solution concentrations ranging from 1 to 10^{-5} molar. The graph of nanopore conductance versus salt concentration was fit to the equation $C = 0.780M + 0.357$, where M is the molarity, to extract the nanopore surface charge value of $-23.6 \pm 2.2 \text{ mC/m}^2$.

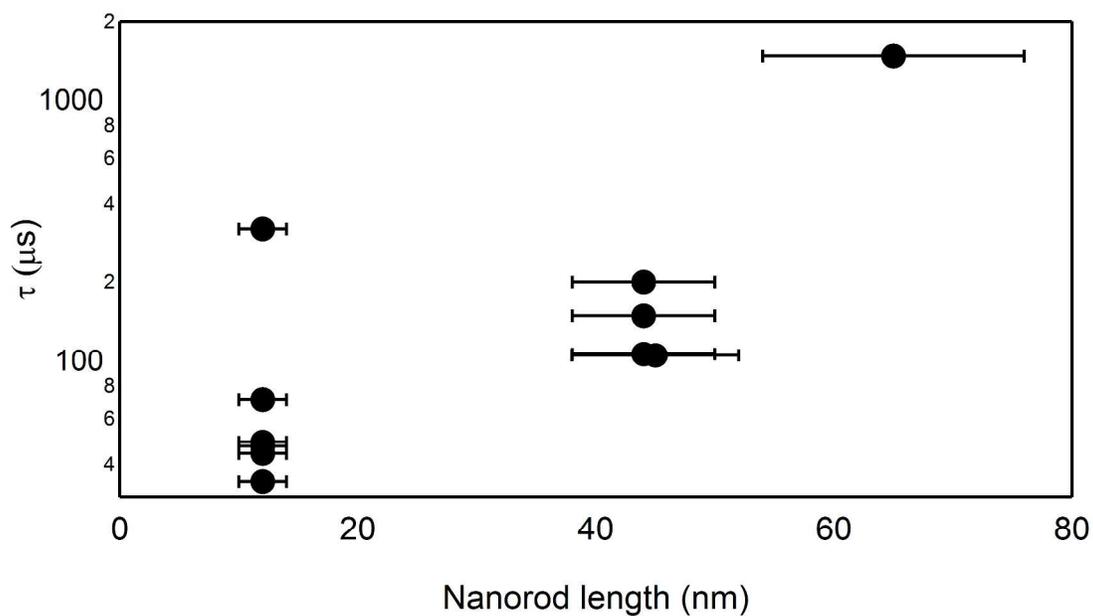


FIGURE S4 Analysis of event duration as a function of nanorod length, where a nanorod length of 12 nm represents a spherical nanoparticle. Y-axis error bars are smaller than the markers. Event duration is defined as the time constant, τ , extracted from a fit of the histogram of event duration to $\exp(-t/\tau)$. Longer nanorods are expected to have longer event durations, because their length affords them more time inside the nanopore. This matches the trend seen previously in DNA translocations¹. All data sets plotted here were measured in 100 mM KCl solution.

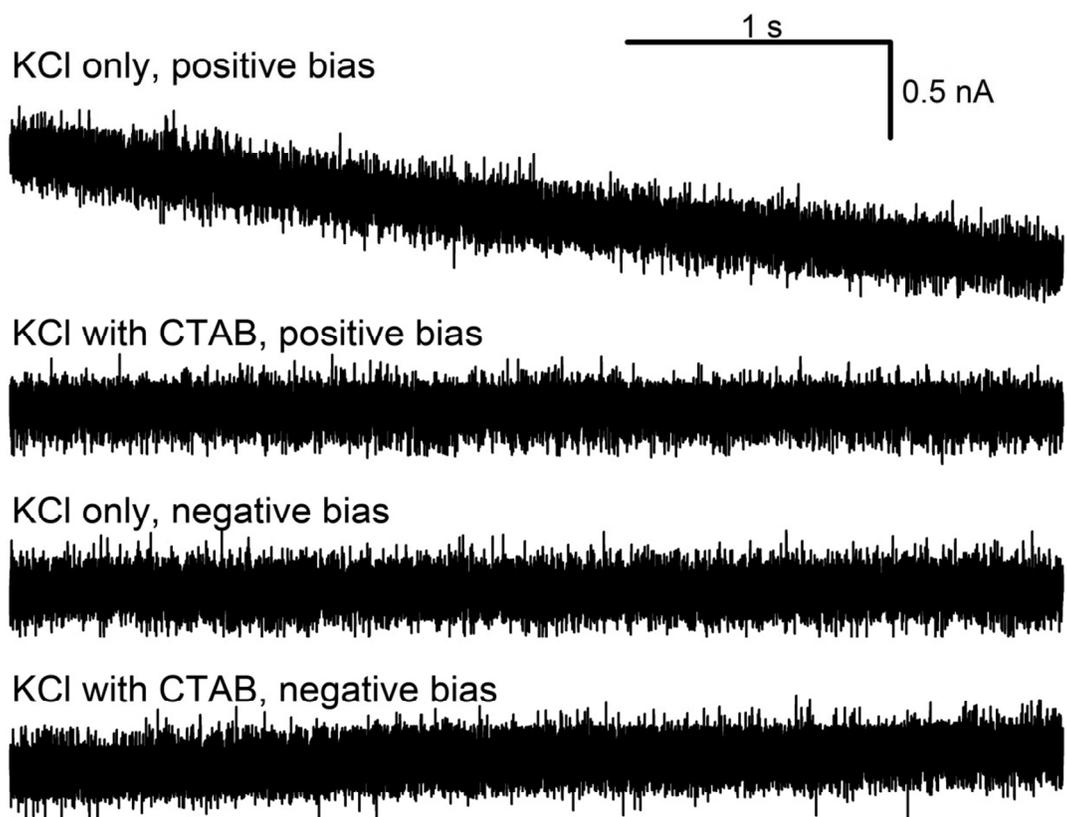


FIGURE S5 Control measurements of ionic current with the ligand molecules only (CTAB control). CTAB was added to 100 mM KCl solution, and the current was monitored for events at either bias. No events similar to gold nanoparticle translocations events shown in the main paper were observed over the course of the experiment. The top trace corresponds to KCl solution at positive bias before addition of CTAB, the second trace from the top corresponds to KCl solution at positive bias after CTAB addition, the third trace from the top corresponds to KCl solution at negative bias before addition of CTAB, and the bottom trace corresponds to KCl solution at negative bias after CTAB addition. The top trace shows some slow capacitive decay, but no traces show evidence of events similar to those observed after adding gold nanoparticles. In conclusion, translocations of CTAB micelles are not observed in our experiments and represent a negligible contribution.

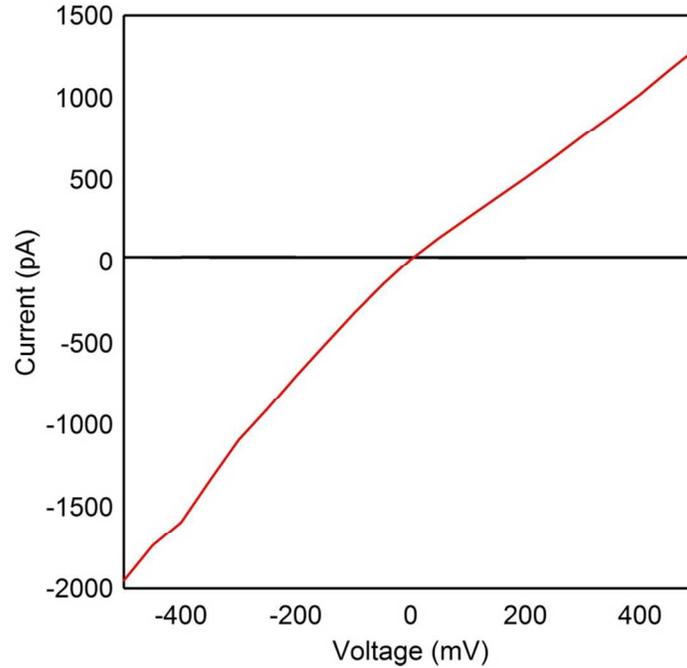


FIGURE S6 Current-voltage curves of ionic current through nanopores in KCl solution (red) and CTAB solution (black). We tested whether CTAB in solution contributes to the nanopore conductance. 10 mM CTAB solution was heated to 70 °C, and then introduced in the fluidic chamber for nanopore measurements. The black current-voltage curve is the resulting measurement showing that the CTAB solution is not conducting. In contrast, a current-voltage curve of a similarly-sized nanopore is shown in red for comparison. The CTAB ionic conductance was found to be less than 1% of the KCl ionic conductance.

REFERENCES

- (1) Storm, A. J.; Storm, C.; Chen, J. H.; Zandbergen, H.; Joanny, J. F.; Dekker, C. *Nano Lett* **2005**, *5*, 1193.