Ångstrom-scale ionic streaming when electrical double-layer concept fails

Jiajia Lu[1], Shuyong Luan[2], Shenghui Guo[1], Libing Duan[1], Guanghua Du[3], and Yanbo Xie[2,*]

[1]*School of Physical Science and Technology, Northwestern Polytechnical University, Xi'an 710072, China*

[2]*National Key Laboratory of Aircraft Configuration Design, School of Aeronautics and Institute of Extreme Mechanics, Northwestern Polytechnical University, Xi'an 710072, China*

[3]*Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, 730000, China*

SUPPLEMENTAL MATERIAL

A. TEM characterization

B. Conductance measurement

C. Additional nonlinear streaming current data

D. Ag/AgCl electrodes characterization

* ybxie@nwpu.edu.cn

A. TEM characterization

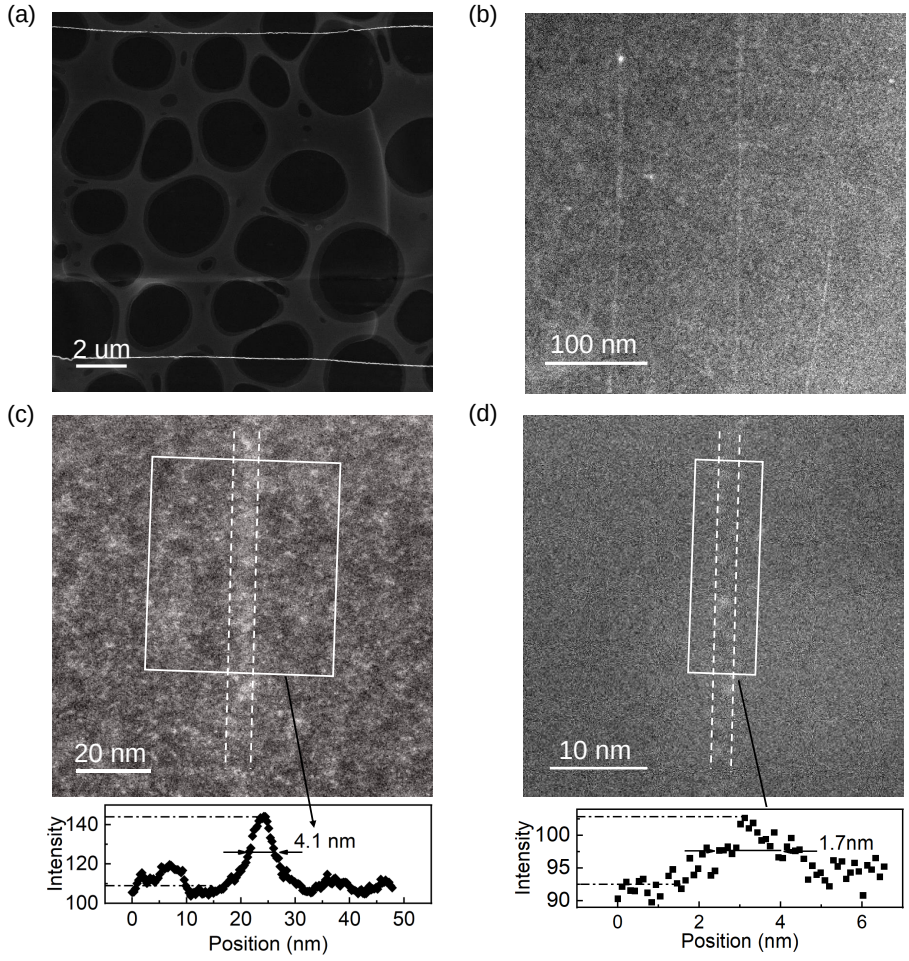

Figure S1. Each specimen was exposed to the vapor of RuO_4 solvent over 20 minutes, to guarantee the their reactions with unsaturated functional groups. We embedded membranes in epoxy resin and sliced into 100 nm pieces by ultrathin slicer LEICA − UC7FC7. (a) Cross-section of 12 μm PET film under TEM, where the scale bar indicates 2 μm. Two bright lines at top and bottom of image were spin-coated gold for location of sliced membranes. (b) Large-area cross-section of stained latent track nanochannels under TEM with a scale bar of 100 nm. The straight bright lines are the stained ruthenium atoms inside of the nanochannels. (c) The stained channel (TA70-40) under TEM with typical dimensions of 20 nm. (d) The stained channel TA70-30 under TEM with typical dimensions of 10 nm. The brightness are statistically counted over the entire area marked in white box using digitalmircrograph software, with the statistics distributed along the direction perpendicular to the bright line.

B. Conductance measurement

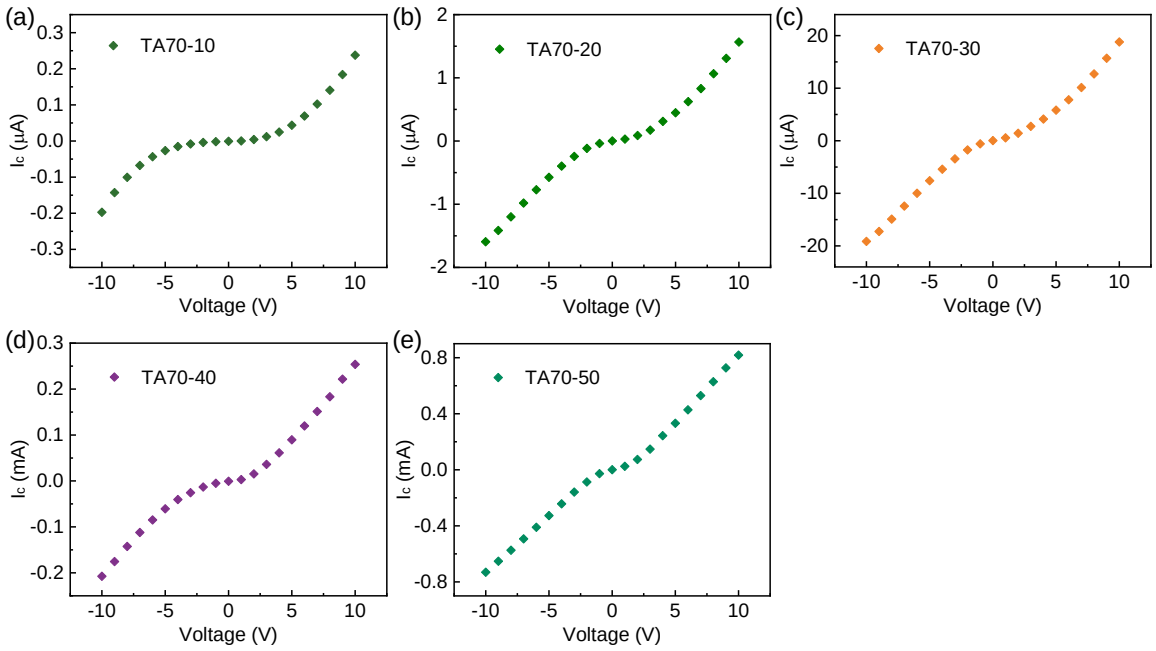

Figure S2. We sealed two PMMA reservoirs and clamping a piece of latent track membrane for the conductance measurement. The conductance of each specimen was measured by sweeping voltage in 0.01 mol/l KCL solution at room temperature. The typical current-voltage (I-V) curves after annealing annealing in water bath at 70 °C for 10 minutes (a), 20 minutes (b), 30 minutes (c), 40 minutes (d), 50 minutes (e). We found the increases of conductance amplitude and reduction of non-linearity as extending of the time of annealing.

C. Additional nonlinear streaming current data

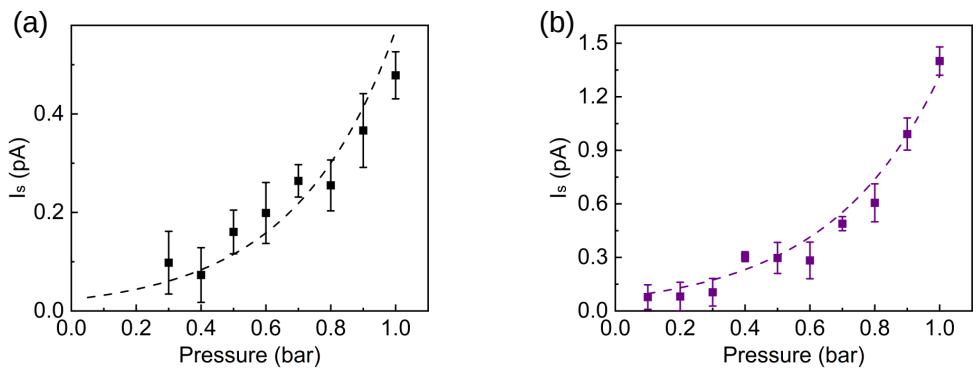

Figure S3. Additional nonlinear streaming current data with specimens TA50 and TA70 − 10. (a) Measurement of streaming current of soft etching in water bath at 50°C for one hour and free of 70 °C annealing latent track nanochannel (TA50). (b) Measurement of streaming current of latent track nanochannel annealing in water bath at 70 °C for 10 minutes (TA70 − 10). The dashed line is the guide line of the streaming current as the pressure changes.

D. Ag/AgCl electrodes characterization

We immersed the two electrodes in a beaker containing 0.01 M KCl electrolyte solution for the experiments. We measured the potentials difference between electrodes by placing them into a using the Sub-femtoamp Remote SourceMeter (Keithley 6430) that shows ~ 3.9 mV difference as seen in Fig. S4, illustrating a good condition for measurements.

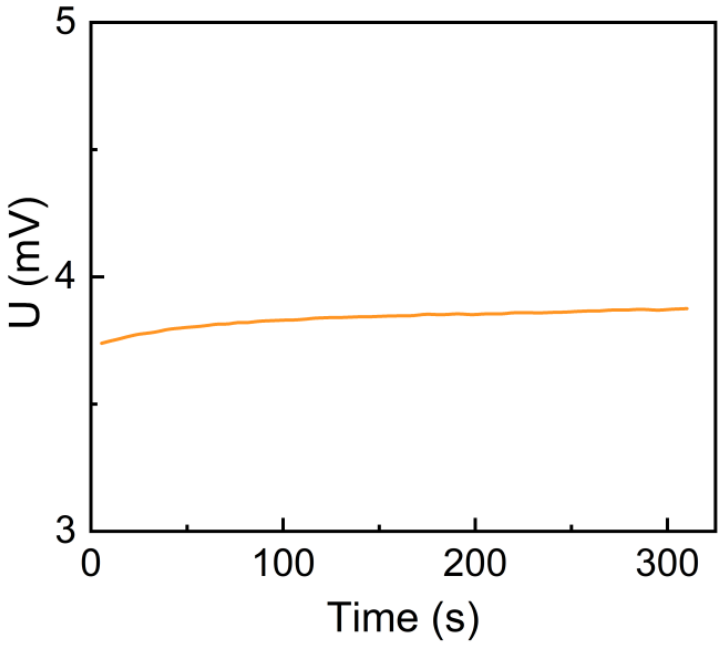

Figure S4. Potential measurement of Ag/AgCl electrodes