Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information

Electrical surface properties of nanoporous alumina membranes: influence of nanochannels' curvature, roughness and composition studied *via* electrokinetic experiments

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Membrane name	Anodization U (V)	2nd Anodization Temperature (°C)	2nd Anodization average current density < j > (mA/cm^2)	Anodization time		Wet etching time at 30 °C (min)	Porosity (%)	
				2nd	3rd (s)		Top	Bottom
OA-0.05	40	17.6	1.79	6 h 39 min	100	29	26	23
OA-0.3	40	18.2	4.66	2 h 34 min	240	16	26	19
OA-0.8	40	18.3	7.17	2 h	87	18	31	21
Sul-0.3 (1)	25	18	4	6 h 4 min	2100	~ 45	45	19
Sul-0.3 (2)	25	18	4.7	6 h	2100	~ 45	48	17
Sel-0.3	45	< 1.7	1.14	21 h 52 min	179	> 70	23	14

Table S1. Summary of the anodization conditions used for the synthesis of AAOs.

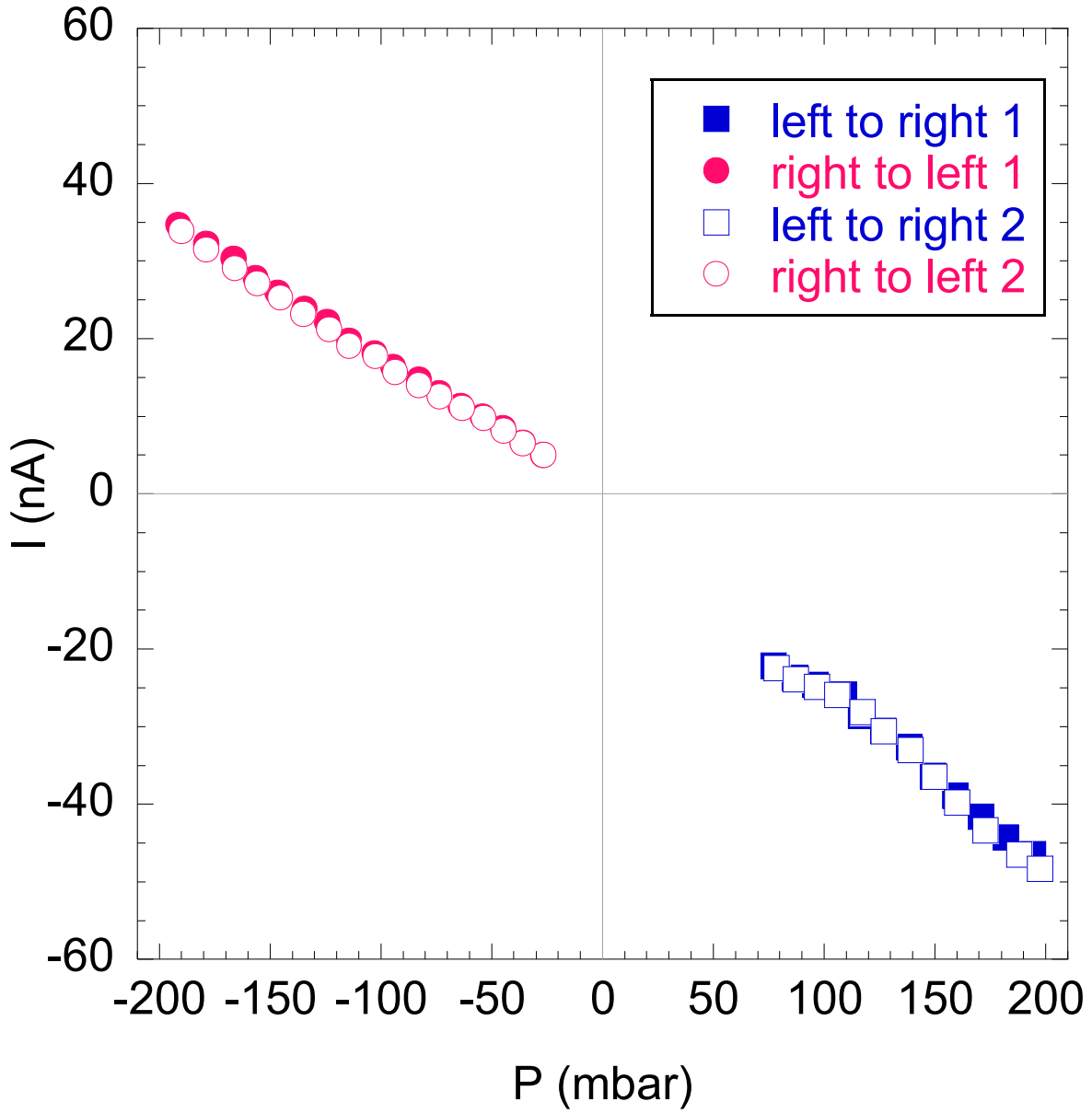

Figure S1. Raw P-I graph of tangential flow streaming current measurement on the top surface of the OA-0.8 AAO membrane at pH=10.4. The measurement composes of four steps: two from left to right (blue) and two in the opposite direction (red) flow.

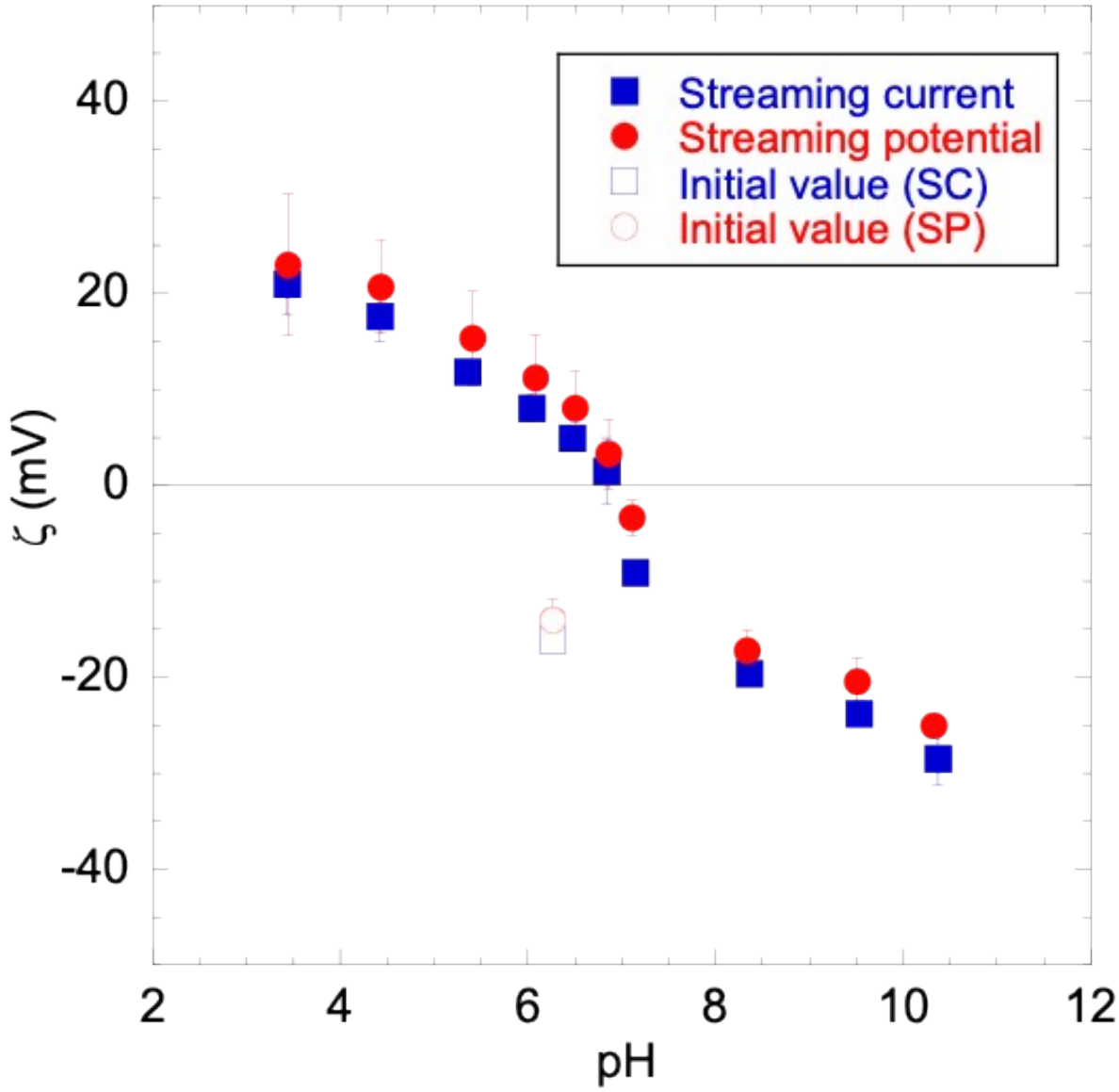

Figure S2. Comparison between the ζ-potential values derived from the streaming current I_s (blue square) and streaming potential U_s (red circles) obtained by tangential SE. The measurements cycle was carried out on the bottom side of the OA-0.8 AAO membrane. The empty symbols show the first measurement in pure KCl solution at pH = 6.3. The initial negative value suggests that the AAO surface is contaminated by impurities. To wash away and desorb theses impurities, the pH is directly adjusted to a high value (pH ≈ 10) and then decreased stepwise down to about 3 and the ζ-potential is measured for each pH.

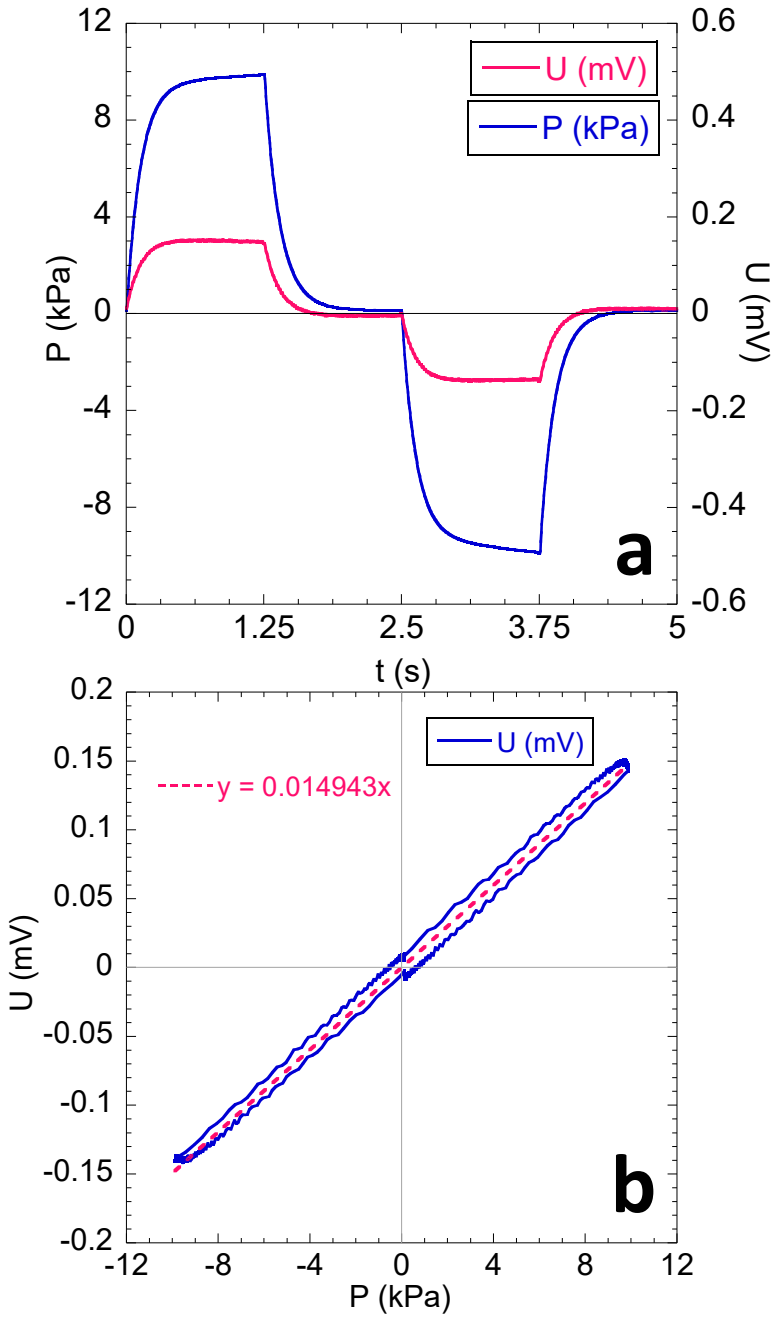

Figure S3. Raw data of the transverse SE for one "back and forth" cycle for OA-0.3 at pH ≈ 6: **a)** pressure P and the resulting voltage U as a function of time **b)** U_s vs P diagram with the corresponding linear fit. The slope of the fit yields the dU/dP that is then converted to the ζ-potential (see main text).

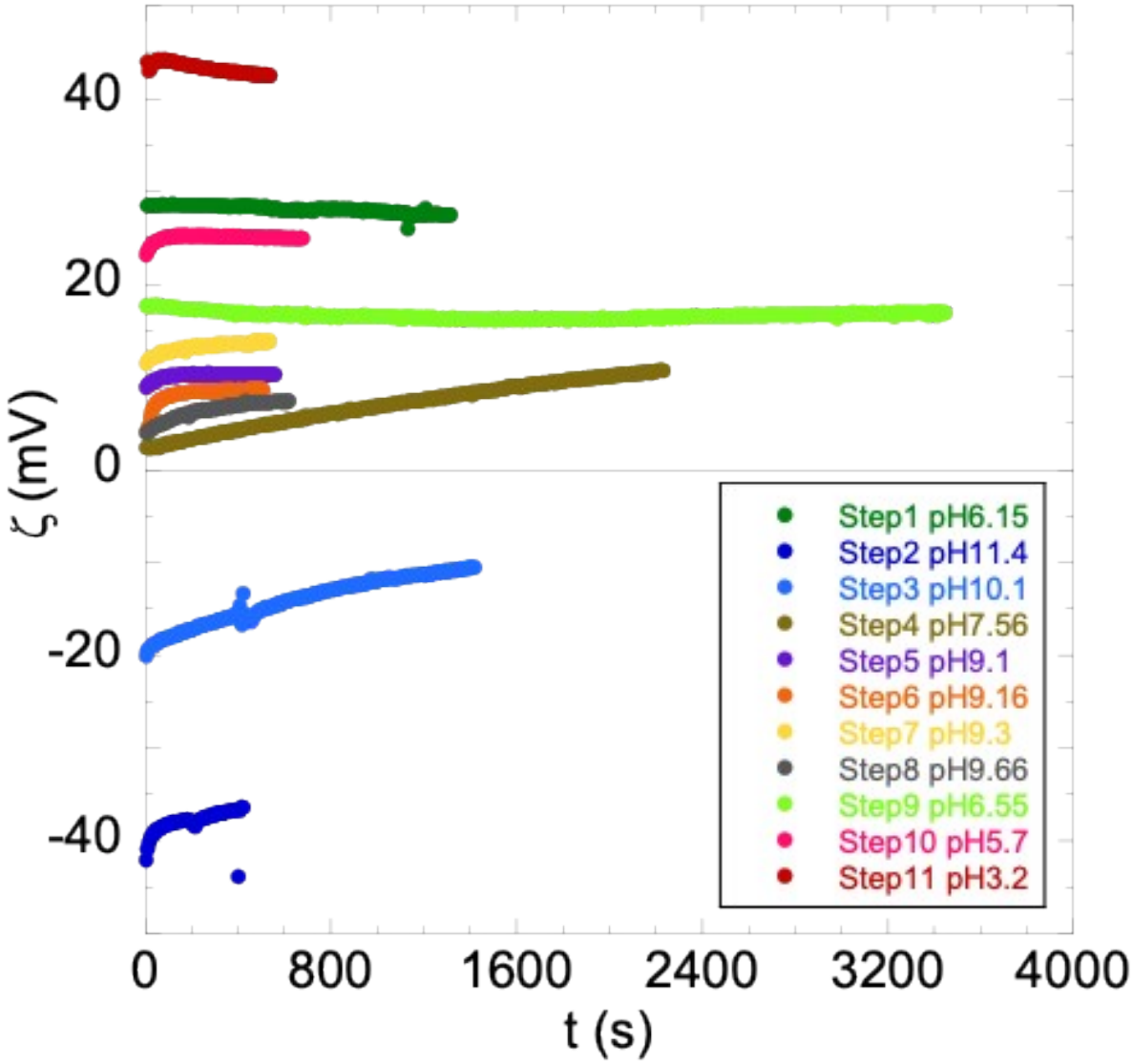

Figure S4. ζ-potential obtained by transverse SE as a function of time at different pHs for OA-0.8 AAO membrane.

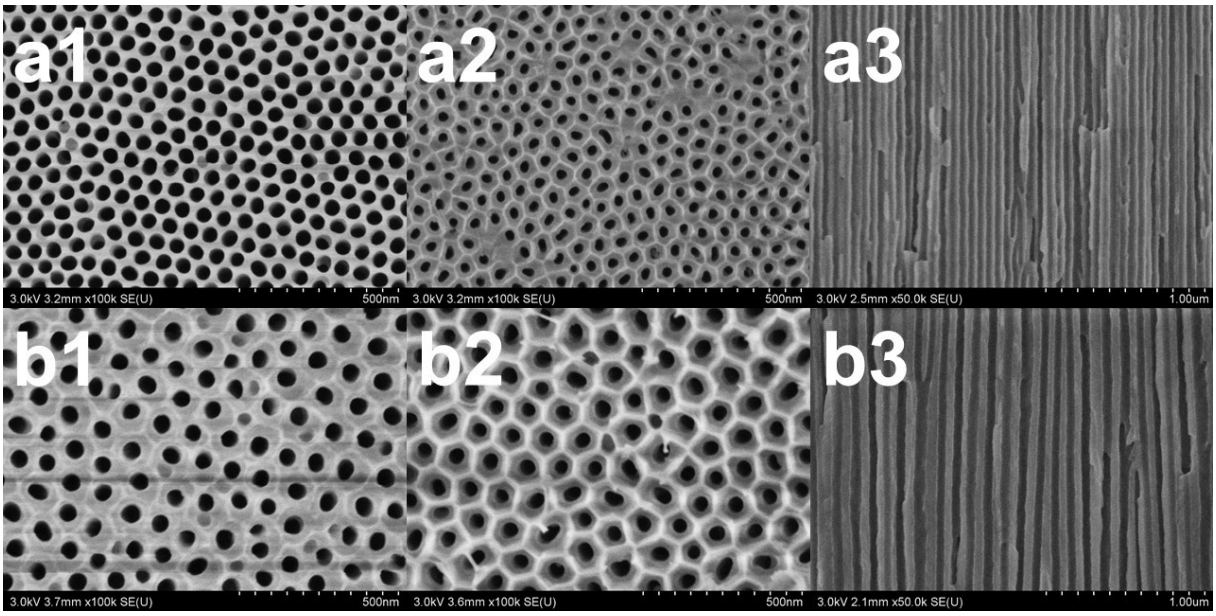

Figure S5. SEM images of the Sul-0.3M and Sel-0.3M membranes as synthesized in **a)** sulfuric acid and **b)** selenic acid 0.3M solutions from **1)** top **2)** bottom and **3)** section.

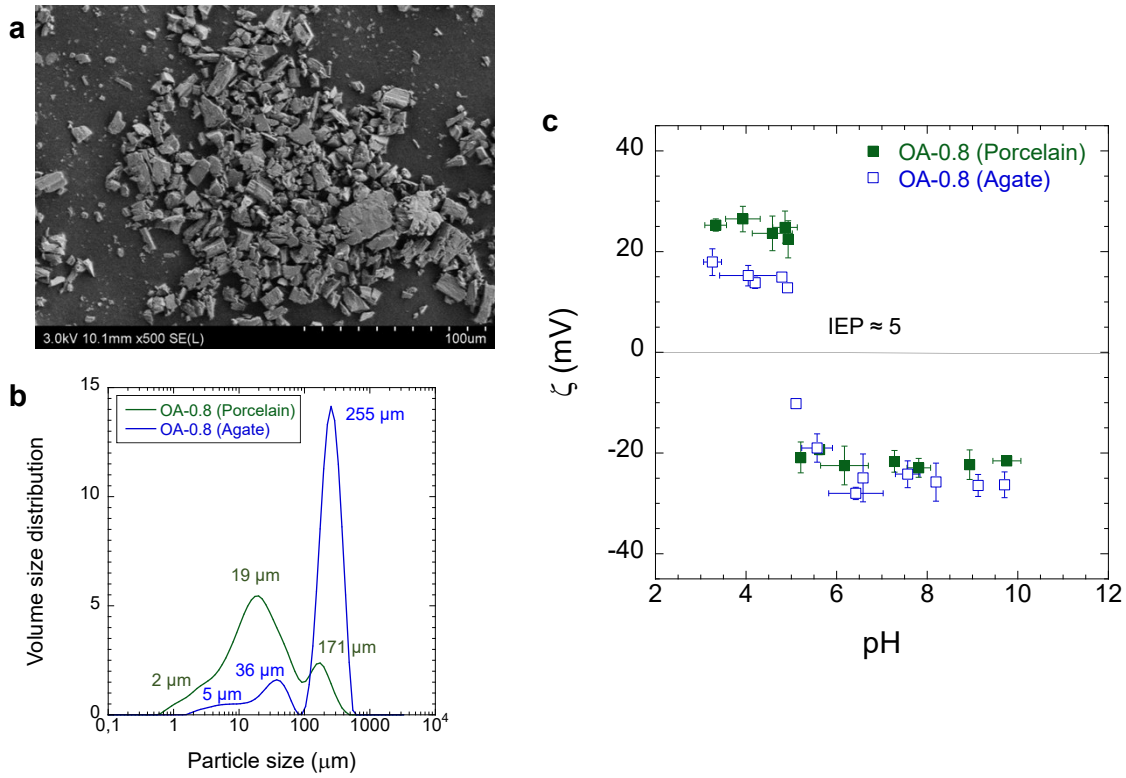

Figure S6. (a) SEM images of OA-0.8 AAO membrane manually grinded with an Agate mortar and pillar. (b) Volume size distribution as a function of particle diameter obtained by laser granulometry for OA-0.8 AAO grinded in porcelain (green line) or Agate (blue line) mortar. The volume size distribution is an average of 5 runs of measurements. (c) ζ-potential of OA-0.8 membranes measured by electrophoretic mobility (EM) of the AAO membrane grinded in porcelain (full green squares) or Agate (open blue squares) mortar.

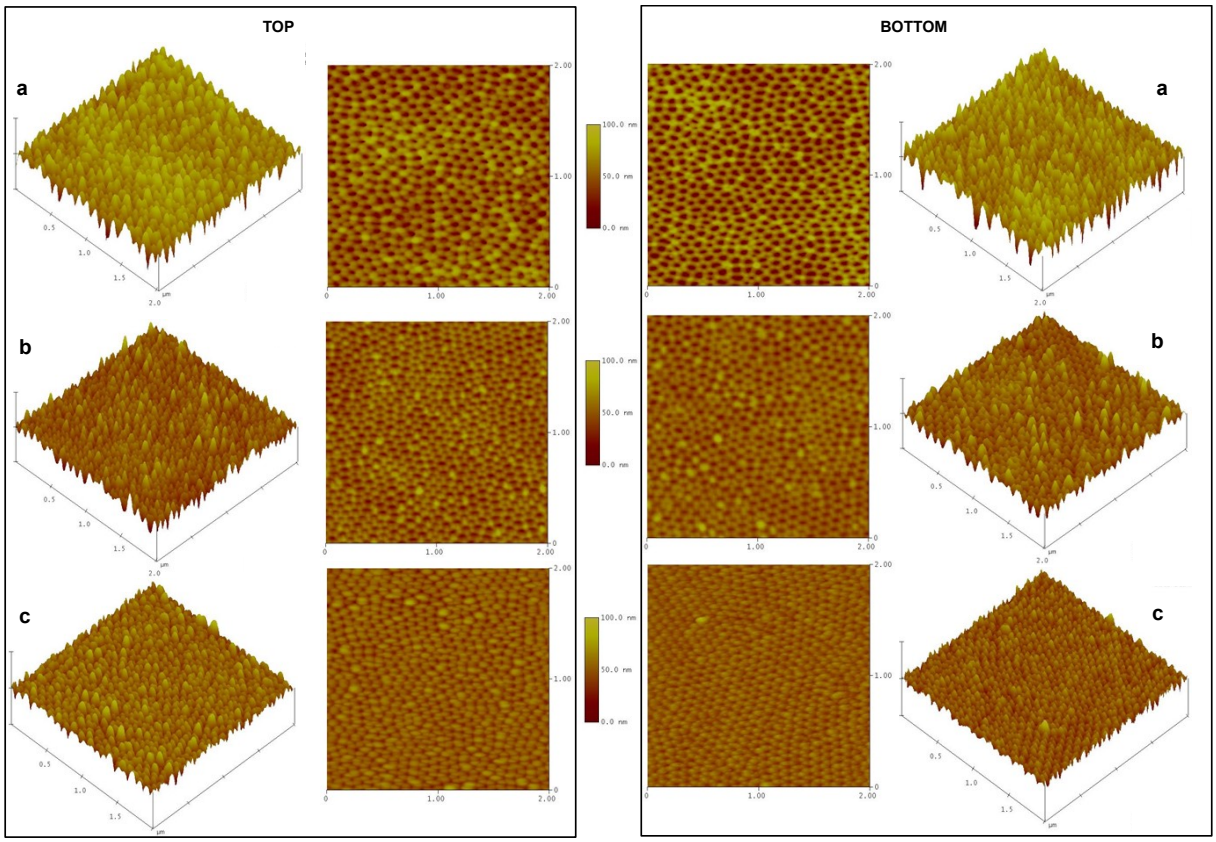

Figure S7. AFM images of top (left side) and bottom (right side) surfaces of AAO membranes: OA-0.05 (a), OA-0.3 (b), OA-0.8 (c). Horizontal scale 2x2 μm and vertical scale 100 nm (0 dark – 100 clear).