SUPPORTING INFORMATION

Alumina Membrane with Hour-Glass Shaped Nanochannels: Tunable Ionic Current Rectification Device Modulated by Ions Gradient

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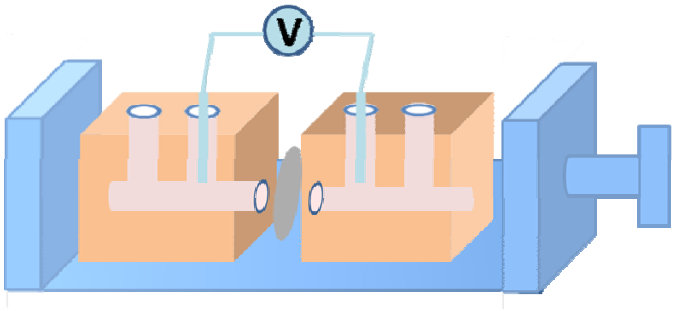

Figure S1. Schematical diagram of the experimental setup for *I*-*V* measurement.

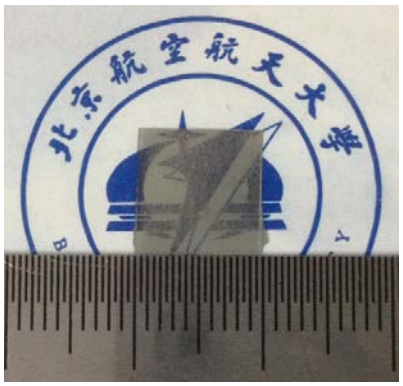

Figure S2. The optical image of the hour-glass shaped alumina membrane. The good transparency is exhibited.

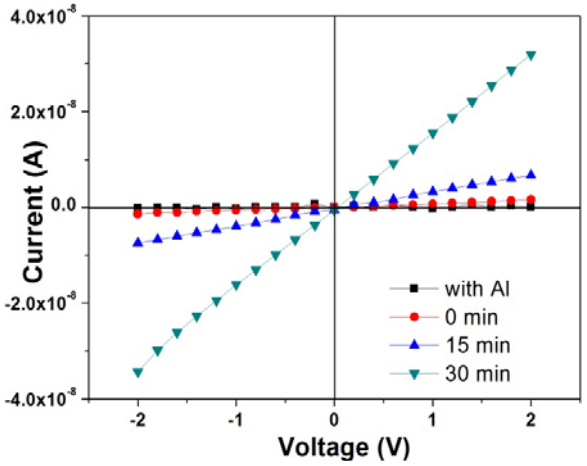

Figure S3. *I-V* curves of as-prepared alumina membrane samples are in the following order: alumina nanotubes with Al substrate (black), double-layer alumina nanotubes that without pore opening (red), and alumina nanochannels with the in-situ pore opening about 15 min (blue) and 30 min (green). All measurements were recorded under symmetric electrolyte conditions at pH 7.0 and 1 mM KCl.

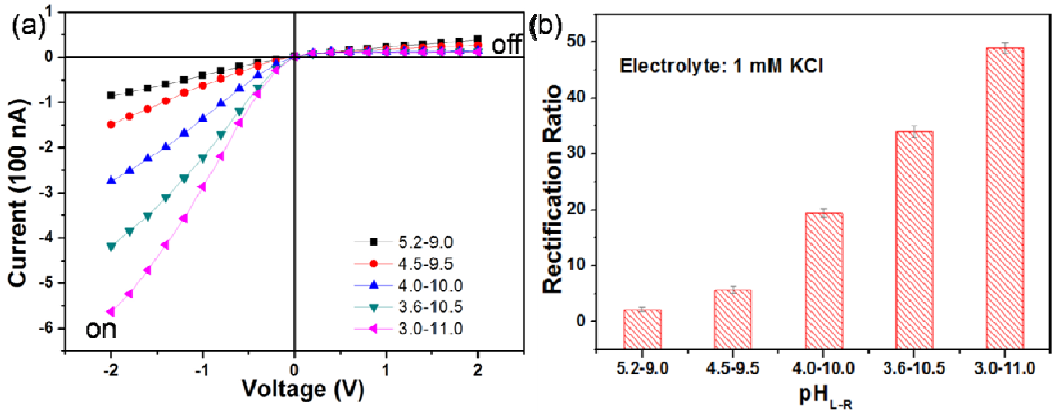

Figure S4. (a) *I-V* curves of the hour-glass shaped alumina nanochannels in asymmetric acid-base conditions, the pH values of two sides of the channel are both changed towards

to the high surface charge density distribution. (b) Ionic rectification ratio of the as-prepared alumina nanochannels. All measurements were recorded in 1 mM KCl with a series of pH gradients.