Nanofluidic Anion Transport through Reconstructed Membrane of Layered Double Hydroxide Nanosheets

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Two-dimensional (2D) materials have been widely studied due to their novel properties distinct from the bulk counterpart compounds.[1,2] Recently, a number of nanosheets with molecular thickness have been successfully obtained by exfoliating their bulk layer materials, thus further accelerating the research on 2D materials.[2] In particular, reconstruction or restacking of nanomaterials creates nanochannels with excellent nanofluidic transport characteristics for applications in bio-sensing, seawater desalination and energy harvesting.[3] There have been previous reports on fabrication of cationic transport devices based on 2D materials such as graphene oxide (GO).[4] However, construction of anionic transport membranes is very rare.

In the present work, a membrane-type nanofluidic device was prepared by self-assembling MgAl LDH nanosheets, which exhibited a remarkable OH^- conductivity of ~2×10^{-2} S cm^{-1} (Fig. 1). The conductivity is much higher than that reported for GO membranes (~0.2×10^{-2} S cm^{-1}). By further tuning the LDH membrane into a triangular shape, a diode behavior for anionic transport has been confirmed. The result demonstrates a great application prospect of using LDH membrane as ion-pump for uphill transport against the concentration gradient.

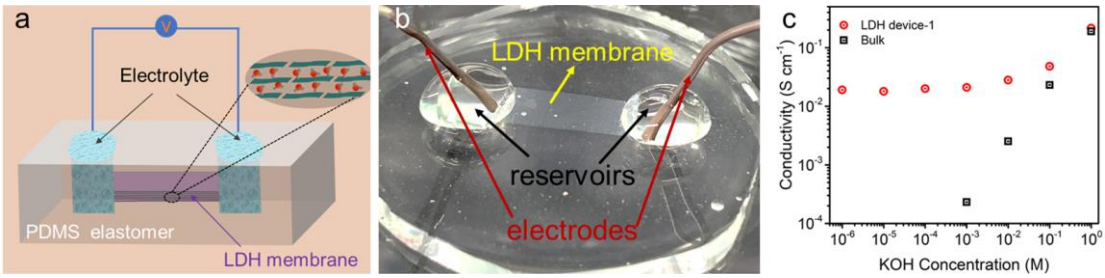

Figure 1. (a) Schematic illustration and (b) digital photo of LDH membrane-based nanofluidic device. (c) Ionic conductivity as a function of KOH concentration. The corresponding conductivities of bulk solution are displayed as references.

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