Accepted Manuscript

Title: Highly rectified ion transport through 2D WSe_2/MoS_2 bi-layered membranes

Authors: Yaping Feng, Liping Ding, Danyan Ji, Lili Wang, Wei Guo

PII:	S1001-8417(18)30073-1
DOI:	https://doi.org/10.1016/j.cclet.2018.01.053
Reference:	CCLET 4443

To appear in: *Chinese Chemical Letters*

Received date:	12-1-2018
Revised date:	19-1-2018
Accepted date:	29-1-2018

Please cite this article as: Yaping Feng, Liping Ding, Danyan Ji, Lili Wang, Wei Guo, Highly rectified ion transport through 2D WSe2/MoS2 bi-layered membranes, Chinese Chemical Letters https://doi.org/10.1016/j.cclet.2018.01.053

Communication

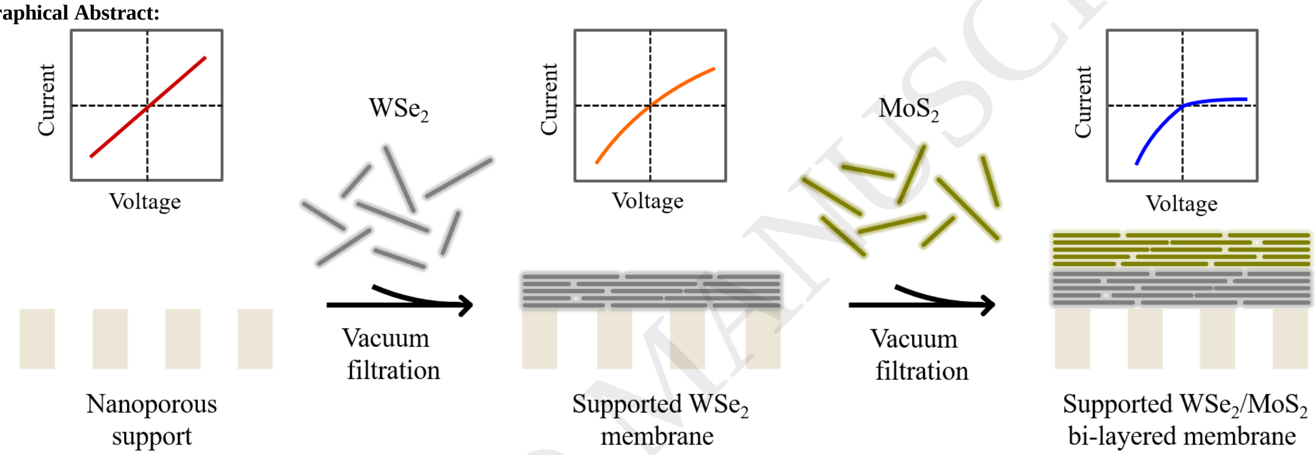
Highly rectified ion transport through 2D WSe_2/MoS_2 bi-layered membranes

Yaping Feng[a,c], Liping Ding[b], Danyan Ji[a,c], Lili Wang[a], Wei Guo[a,*]

[a] CAS Key Laboratory of Bio-inspired Materials and Interfacial Science, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Beijing 100190, China.
[b] Center for Physiochemical Analysis and Measurement, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China.
[c] University of Chinese Academy of Sciences, Beijing 100049, China.

[*] **Corresponding author**:
E-mail address: wguo@iccas.ac.cn (W. Guo).

Graphical Abstract:



Through a two-step vacuum-filtration process, WSe_2 and MoS_2 nanosheets were sequentially deposited onto a polymeric nanoporous support, forming WSe_2/MoS_2 bi-layered heterostructure. Highly rectified ion transport phenomenon is observed through the heterogeneous 2D layered membranes.

ARTICLE INFO

Article history:
Received 13 January 2018
Received in revised form 19 January 2018
Accepted 25 January 2018
Available online

Keywords:
Ion transport
Rectification
2D materials
Nanofluidics
Heterostructure

ABSTRACT

Two-dimensional (2D) nanofluidic systems provide a highly efficient way to integrate a huge amount of cascading lamellar nanofluidic channels into macroscopic membrane materials for practical use in, for example, molecular separation, water treatment, and energy storage. Besides the well-studied graphene-based materials, other 2D nanomaterials, such as the transition metal dichalcogenides (TMDCs), are expected as promising alternatives. Here, we report strong ionic current rectification (ICR) effect found in MoS_2/WSe_2 bi-layered membrane structure. The preferential direction for ion transport is from the WSe_2 layers to the MoS_2 layers. The maximum ICR ratio approaches 35 at intermediate electrolyte concentration. More intriguingly, by exchanging the deposition order of the MoS_2 and WSe_2 layers, the observed ICR effect can be reversed. These evidences justify that the highly rectified ion transport phenomenon results from the asymmetry in the reconstructed 2D layered materials. This work is the first discovery of ICR effect in 2D nanofluidic heterostructures, and provides further opportunities for innovative nanofluidic devices and materials.

Inspirited by the microstructure of nacre, the material design and large-scale integration of artificial nanofluidic devices step into a completely new stage, termed “2D nanofluidics” [1, 2]. *Via* the exfoliation-reconstruction strategy, a lamellar configuration can be constructed by restacking the dispersed 2D nanosheets in liquid phase [3, 4]. The interstitial space can be generally considered as lamellar nanochannels that allows the transport of molecular cargoes and ionic species [5]. The nacre-inspired 2D layered membrane provides a solution for large-scale integration of cascading lamellar nanofluidic channels into macroscopic membrane materials for practical use, such as molecular separation, water treatment, and energy storage [6-8]. Besides the most well-studied graphene-based