Understanding the exfoliated MoS_2/GO membrane stability during water filtration

Hokkaido Univ [1], UNESCO Centre, UNSW [2] ○Meiqi Zhang[1], Boyue Lian[2], Gregory Leslie[2], Toshihiro Shimada[1]

E-mail: zhangm7_hoku@eis.hokudai.ac.jp

Introduction: Two-dimensional materials represented by graphene are attracting extensive research. Due to excellent chemical properties, they are not only having very good potential in the fields of semiconductors but a good performance in water treatment. Now, the widely studied layer stacked graphene oxide (GO) membranes have shown a potential for desalination, water purification, oil and water separation, and antifouling coating, but are suffering from their instability in water. On the other hand, researchers began to explore the other two-dimensional layered materials in water treatment, in which molybdenum disulfide (MoS_2) is gathering attention because of its high-water flux [1]. In this study, we attempted to prepare a MoS_2/GO membrane to examine its water stability and separation performance.

Experiments: MoS_2 flakes were obtained by direct liquid-phase exfoliation method from bulk using sonication and centrifugation. GO is made by Hummers' method. The membrane was fabricated from the mixture solutions, and the water flux and methylene blue rejection test was done in fully wet conditions.

Results: The main structure of the membrane is constituted by GO, and MoS_2 flakes are inserted in the membrane, the diameter is about 1 μm. The SEM image with the cross-section of membrane is shown in Fig.1. In the case of pure GO membrane, layered GO material in the surface of the membrane is rapidly peeling and dispersed in the water, when it enters into water in the completely wet condition. In contrast, this phenomenon of surface peeling and dispersion in the MoS_2/GO membrane is greatly reduced. The experimental results show that this simple fabrication method of MoS_2/GO membrane can effectively improve the stability of the membrane in water and maintain high water flux and methyl blue rejection rate. We are trying to reveal this phenomenon using theoretical calculations now.

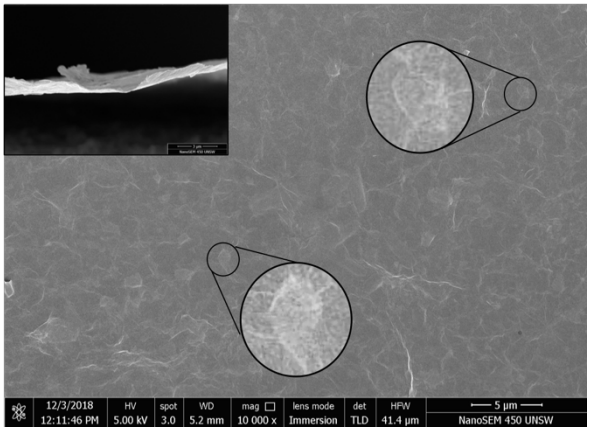

Fig.1. SEM image of MoS_2/GO membrane.

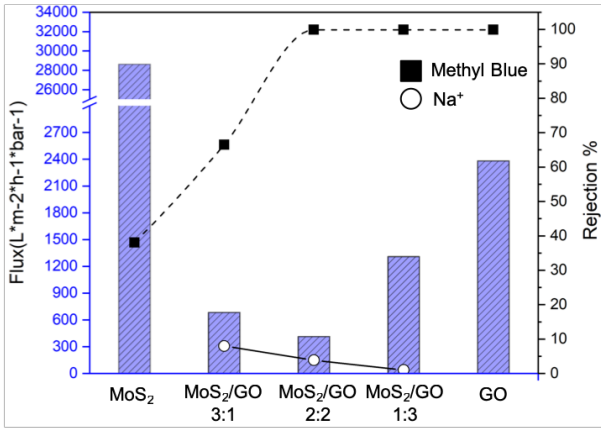

Fig. 2 Flux-rejection performance.

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