

Magnetic Orientation and Alignment Control of LDH-Containing Composite Membranes for Enhanced Anion Conductivity

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1. Introduction

Layered double hydroxides (LDHs) are inorganic particles with exceptionally high anion conductivity, and their incorporation can enhance the performance of polymer-based anion exchange membranes. However, since anion exchange in LDHs primarily occurs along the interlayer direction, randomly oriented LDHs may hinder efficient anion transport. In this study, we aim to clarify the magnetic responsiveness of LDHs and to achieve orientation control of LDHs within composite membranes using magnetic fields.[1]

2. Experimental

MgAl-LDH and NiAl-LDH were used as the LDH fillers, and composite membranes containing 10 wt% of each LDH were prepared under both magnetic field and no-field conditions. The orientation of the LDH within the composite membranes was evaluated by wide-angle X-ray diffraction (WAXD).

3. Results and Discussion

As shown in Figure 1, magnetic orientation was observed for both MgAl-LDH and NiAl-LDH, with each exhibiting a different easy axis of magnetization. As shown in Figure 2, the membranes in which LDHs were properly aligned by the magnetic field demonstrated superior anion conductivity. These results indicate the effectiveness of magnetic processing for LDH-containing anion-conducting composite membranes.

Reference:

[1] Yamato, M., Shinada, Y., Ushijima, E., Takahashi, K. (2025). *Chemistry Letters*, 54(1) upae250.

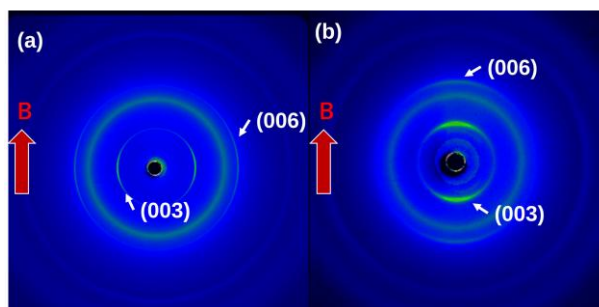


Fig. 1. The 2D-WAXD patterns of composite membranes of Mg-Al LDH (a) and Ni-Al LDH (b) with PVA/PDDA fabricated in a 10 T magnetic field.

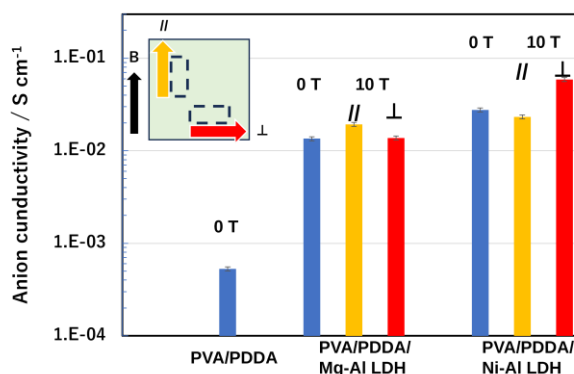


Fig. 2. The anion conductivity for the PVA/PDDA membrane and the PVA/PDDA/LDH membranes prepared outside and inside a magnetic field. The inset shows the direction of the applied magnetic field during the preparation of the composite membrane and the direction of anion conductivity measurement.