Partially Reduced Graphene Oxide Membrane with High Ion Selectivity and Proton Flux for Vanadium Redox Flow Battery

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Abstract

Vanadium redox flow battery is one of the most competitive large-scale energy storage systems, which has already been tested in tens to hundreds of MWh scale.[1] Commercial Nafion membrane is mostly used in the VRFB systems. However, there is still room for performance improvement due to its limited vanadium ion-to-proton selectivity and long-term stability.[2] This study demonstrated partially reduced graphene oxide membranes (PrGOMs) with ~160 nm thickness for VRFB by vacuum filtration and mild thermal reduction. The interlayer space between graphene oxide nanoflakes was controlled by reduction temperature, as illustrated in Figure 1. High proton flux, low vanadium crossover, and improved chemical and physical stability were achieved with optimum reduction degree. The PrGOM had 2.8 times lower membrane area resistance in 1M H_2SO_4 and 9 times better ion selectivity than Nafion membranes. Swelling behavior in electrolytes with high ion concentration and acidity was studied to understand ion transport in the PrGOMs.

References

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Figures

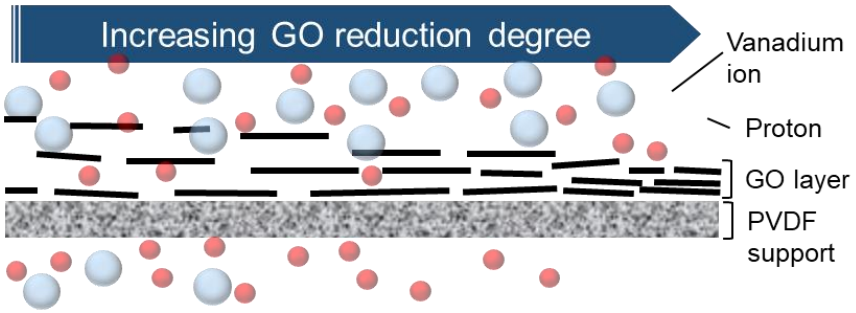

Figure 1: Schematic illustration of ion transport through interlayer spacing-controlled graphene oxide membrane with different reduction degree.