Ultrathin graphene-based membrane for precise and ultrafast organic solvent nanofiltration

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Abstract

Graphene oxide (GO) membranes continue to attract intense interest due to their unique molecular sieving properties combined with fast permeation rates. However, the membranes' use has been limited mostly to aqueous solutions because GO membranes appear to be impermeable to organic solvents[1-2], a phenomenon not fully understood yet. Here, I will present efficient and fast filtration of organic solutions through ultrathin and highly aligned GO laminates containing smooth two-dimensional (2D) capillaries made from flakes with large sizes of ~ 10-20 μm. Without sacrificing their sieving characteristics(Figure. 1a), such membranes can be made exceptionally thin, down to ~10 nm, which translates into fast permeation of not only water but also organic solvents. The presence of randomly distributed pinholes that are interconnected by short graphene channels with a width of 1 nm is attributed to the organic solvent permeation and sieving properties of ultrathin GO laminates. With increasing the membrane thickness, the organic solvent permeation rates decay exponentially but water continues to permeate fast, in agreement with previous reports[1-3]. The application potential of the ultrathin laminates for organic-solvent nanofiltration is demonstrated by showing >99.9% rejection of various organic dyes with small molecular weights dissolved in methanol(Figure 1b). Our work significantly expands possibilities for the use of GO membranes in purification, filtration and related technologies[3].

References

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Figure

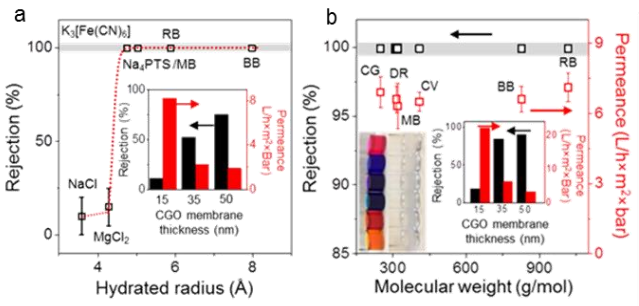

Figure 1: (a)Molecular sieving and (b) organic solvent nanofiltration through ultrathin GO membranes.