Graphene Oxide Membranes for Selective Molecular Separation of Lignin Model Compounds

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Abstract:

In our quest for selective separation of value lignin monomers, performance of Graphene Oxide-based (GO) membranes was investigated with model lignin monomeric compounds. GO membranes were fabricated on a commercially available polyvinylidene fluoride support (PVDF) by casting aqueous GO dispersion using wire wound rod. Degree of reduction of GO was controlled to tune the performance of GO membranes towards selective separation. GO membranes were thoroughly characterized to establish the chemical state of GO and to establish membrane performance parameters. Efficacy of these membranes towards rejection and separation of value lignin model compounds (dimers and trimers) was verified. Impressive performance with rejection of over 70% for the model compound BMP (trimer-2,6-Bis[(2-hydroxy-5-methylphenyl)methyl]-4-methylphenol) was achieved compared to only 20% rejection for GGE (dimer-Guaiacylglycerol-β-guaiacylether) with isopropanol-water (90%-10% by volume) mixture as solvent. This corresponds to an encouraging selective separation with selective permeation of GGE (dimer) 3.5 times compared to BMP (trimer). We hypothesize that the steric hindrance effect plays the most important role in the excellent molecular rejection and separation performance of our membranes. Moreover, the controlled reduction of GO membranes by varying thermal incubation time was achieved. A decline in the rejection rate with increasing extent of reduction was observed which was explained based on the higher partitioning of lignin derived molecules on the more hydrophobic domain. The present contribution identifies the impressive performance of GO membranes for selective separation of value lignin monomers in polar organic solvent media.