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Title:

Boron nitride hybrid membranes for water purification and hydrogen separation

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Boron nitride nanosheet, as a representative of two-dimensional (2D) materials, has atomic thickness and unique physiochemical properties such as tuneable functionality, high chemical and thermal resistance. Thus, it emerges as an ideal material for enhancing the stability and performance of conventional polymeric membranes and innovating molecular-sieving membranes with fast molecule transport for water purification and hydrogen separation.

Modifying polyamide membranes with two-dimensional nanomaterials has proven effective for enhancing water flux and salt rejection and membrane resistance against fouling and chlorine. In the first study, we prepared a novel thin-film nanocomposite reverse osmosis membrane by embedding functionalized boron nitride nanosheets into the polyamide layer via an in situ interfacial polymerization process. As a result of the incorporation of functionalized boron nitride nanosheets, the expansion of the homogeneous leaf-like structure of the polyamide layer, as indicated by the increased surface roughness as well as the thinner and more hydrophilic active layer, enhances the water permeance of the membrane while maintaining a high salt rejection. The resultant membranes also demonstrate improved chlorine resistance and performance stability under various stress test conditions when compared to the pristine membrane.

Nano-constructing two-dimensional materials into hybrid membranes with molecular-level channels promisingly fabricates advanced membranes for fast and selective gas molecule transport. Herein, we use a high-temperature pyrolysis approach to prepare heterostructures with boron nitride nanosheets as the nano-bricks and graphene nanosheets as the filler. The boron nitride combing graphene nanosheets form precise in-plane and plane-to-plane slit-like nanochannels of ~ 3.0 Å, thus achieving fast transport pathways for hydrogen molecules. The heterostructured membrane shows a high H_2 permeability of 849 Barrer, with an H_2/CO_2 selectivity of 290. This study provides a great opportunity to fabricate hybrid membranes for improving gas purification processes.