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Title:

Confined and mediated intercalation of nanoparticles in graphene oxide membrane to fine-tune desalination performance

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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.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.
Introduction: Clearly state the purpose of the abstract
Methods: Describe your selection of observations or experimental subjects clearly
Results: Present your results in a logical sequence in text, tables and illustrations
Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Multilayered graphene oxide (GO) membranes with interlayered sub-nanometer channels have attracted considerable interest for selective water and ion transport. However, the tortuous transport pathways and water-swelling characteristics of GO laminates hinder the desalination performance of such membranes. Modifying the interlayer through nanoparticle intercalation is one of the most prevalently employed methods of enlarging the nanochannels for rapid transport. However, this generally results in significantly reduced separation precision. In this study, we develop a confined interlayer with mediated nanoparticle intercalation to precisely modulate GO membranes. Enhanced water transport and high ion retardation were simultaneously achieved. We investigated the roles of confinement and mediation in the intercalation modification of GO laminates and highlighted their indispensability in realizing an efficient and effective desalination process.

The pristine rGO membranes exhibited high rejection of Na_2SO_4 (97.0%) but low permeance (0.22 L m^{-2} h^{-1} bar^{-1}) as a result of the tight packing of nanosheets with small interlayer spacing (Figure 1). With the intercalation of GQD, water permeance of the GQD/rGO membrane was increased to 0.49 L m^{-2} h^{-1} bar^{-1}, with slightly compromised salt rejection. In contrast, the GQD-Ag/rGO membrane exhibited water permeance five times 1.12 L m^{-2} h^{-1} bar^{-1} than that of pristine rGO membranes, while maintaining relatively high Na_2SO_4 rejection (94.6%). The performance of rGO membranes intercalated with only Ag nanoparticles (without GQD) were also investigated. Comparatively, while the Ag/rGO membrane synthesized via intercalation of bare Ag nanoparticles could further improve permeance to an extent (1.36 L m^{-2} h^{-1} bar^{-1}), its salt rejection was largely compromised (84.5% Na_2SO_4). It was found that: the improvement of water permeance is related to the size and distribution of nanoparticles; GQD plays a critical role in improving the compatibility between nanoparticles and GO for maintaining high salt rejection.

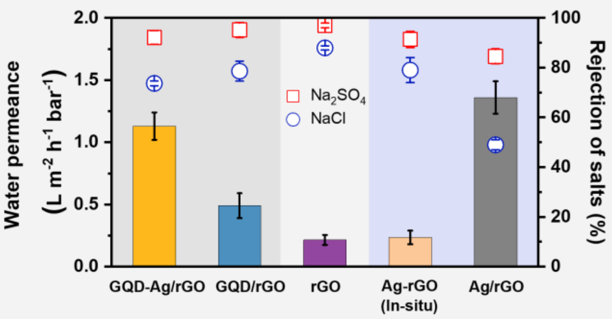

Figure 1. Separation performance of pristine rGO, GQD/rGO, GQD-Ag/rGO, Ag/rGO, and Ag-rGO (in-situ growth).