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Interlayer nanostructured reduced graphene oxide lamellar membrane for desalination

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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.
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Two-dimensional (2D) lamellar membranes are versatile in desalination applications with tunable nanochannels and functionalities. And the interlayer nanostructure of the 2D lamellar membranes is important for efficient water permeation with high salt rejection. To utilize frictionless carbonaceous surface of the graphene nanosheets while mitigating the high transport resistance due to the narrow interlayer spacing, in this work, we developed a new strategy of site-directed incorporation of Prussian blue (PB) nanoparticles into a thermally reduced graphene oxide (rGO) lamellar membrane to enable high water flux for evaporation-based desalination.

This thin nanostructured lamellar membrane was fabricated by vacuum filtration of *in situ* synthesized GO/PB composite nanosheets followed by thermal reduction to remove most of the hydroxide groups and gain hydrophobicity. In this way, the nanoparticles were uniformly coordinated to the functionalized regions of the nanosheets with support for the additional nanoscale water channels. In addition, the interlayer distances between the pristine graphene regions were increased. This structure simultaneously reduced the water transport resistance from the remaining oxygen-containing groups and increased the water permeation at the particle-free surfaces.

As a result, the composite membrane showed 25 times higher flux than the unmodified rGO membrane and a remarkably competitive evaporation-based desalination performance compared to other state-of-the-art membranes. The applicability of this strategy for producing nanostructured lamellar membranes in high-performance desalination is thus demonstrated.