

Improved Water Flux of Polyamide Reverse Osmosis Membrane Ontology Doping with g-C₃N₄

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Seawater desalination technology is one of the most important ways to solve water shortage. Reverse osmosis membrane is the most widely used desalination technology in the world, and polyamide reverse osmosis membrane is the most commonly utilized membrane material. For membrane method, increasing water flux is a critical important research topic since high-water flux not only enables mass production of seawater desalination but also reduce the production cost. Bulk doping modification is one of important methods to improve the flux, and nanomaterials have been extensively investigated as additive materials.

In our experiments, graphitic carbon nitride (g-C₃N₄) was investigated as additive material due to its graphene-like structure and good hydrophilicity. The g-C₃N₄ was prepared by one step thermal polymerization method. Briefly, urea was heated in a muffle furnace with a heating rate of 5 °C/min from 20 °C to 550 °C and kept at 550 °C for 2 h. The sample was cooled down to room temperature, and then it was ground into powder. The polyamide membrane was modified by interfacial polymerization. Firstly, 2 wt. % m-phenylenediamine (MPD) aqueous solution with different concentrations of g-C₃N₄ was used to soak polysulfone (PS) membrane for 5 min. After the redundant aqueous solution on the membrane surface was removed, the membrane was soaked by 0.1 wt. % trimesoyl chloride (TMC) organic solution for 60 s to conduct interfacial polymerization between TMC and MPD. Finally, the modified membrane was obtained.

As shown in Figure 1a, g-C₃N₄ exhibits two-dimensional sheet morphology like graphene and graphene oxide. The morphologies of pristine and modified membranes are demonstrated in Figures. 1b and 1c, respectively. Many typical small cochlear structures can be found in pristine membrane (Figure 1b), and there are variations in the morphology of g-C₃N₄ modified membranes (Figure 1c). The membrane surface is covered with few g-C₃N₄ sheets and with significant wrinkles. It is worth noting that the g-C₃N₄ modified membrane demonstrates higher water flux than pristine membrane (Figure 1d). Membrane water flux and salt rejection were evaluated using a cross-flow system with 2000 ppm NaCl feed solution under operating pressure 1.5 MPa. We can see from Figure 1d that water flux is improved with the increase of g-C₃N₄ concentration. At a concentration of 0.05g/L, the flux is 8.0 L/m²h much higher than 4.3 L/m²h of pristine membrane. Considering both water flux and salt rejection, 0.01g/L is the optimal concentration for desalination characteristics of the modified membrane with 6.0 L/m²h water flux and 98.3% salt rejection. Therefore, the modified membranes doped with g-C₃N₄ demonstrate obviously improved water flux, and both water flux and salt rejection are enhanced with a concentration of 0.01g/L g-C₃N₄.

References:

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 [2] F.F. Shao *et al*, *Desalination* **423** (2017), p.21.
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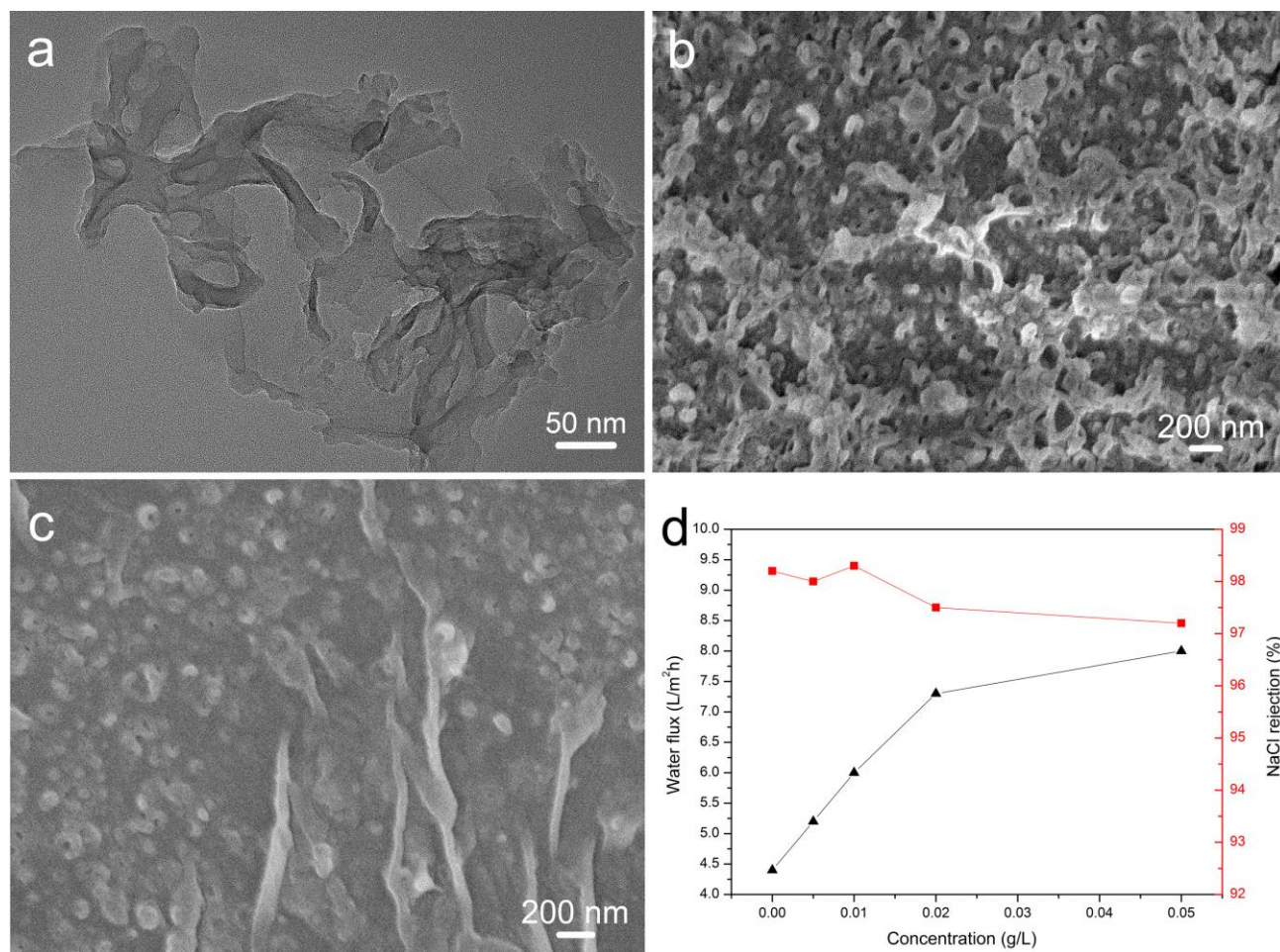


Figure 1. TEM image of g-C₃N₄ (a), SEM images of pristine (b) and modified polyamide membrane (c), and separation performances of modified polyamide membranes with various g-C₃N₄ concentrations (d).