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Removal of Na_2SO_4 by Electro-Confinement on Nanoporous Carbon Membrane

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Abstract : We reported electro-confinement desalination (ECMD), a desalination method combining electric field effects and confinement effects using nanoporous carbon membranes as electrode. A carbon membrane with average pore size of 8.3 nm was prepared by organic sol-gel method. The precursor of support was prepared by curing porous phenol resin tube. Resorcinol-formaldehyde sol was coated on porous tubular resin support. The membrane was obtained by carbonisation of coated support. A well-combined top layer with the thickness of 35 μm was supported by macroporous support. Measurements of molecular weight cut-off using polyethylene glycol showed the average pore size of 8.3 nm. High salt rejection can be achieved because the water molecules need not overcome high energy barriers in confined space, while huge inherent dehydration energy was required for hydrated ions to enter the nanochannels. Additionally, carbon membrane with additional electric field can be used as an integrated membrane electrode combining the effects of confinement and electric potential gradient. Such membrane electrode can repel co-ions and attract counter-ions using pressure as the driving force for mass transport. When the carbon membrane was set as cathode, the rejection of SO_4^{2-} was 94.89%, while the removal of Na^+ was less than 20%. We set carbon membrane as anode chamber to treat the effluent water from the cathode chamber. The rejection of SO_4^{2-} and Na^+ reached to 100% and 88.86%, respectively. ECMD will be a promising energy efficient method for salt rejection.

Keywords : nanoporous carbon membrane, confined effect, electric field, desalination, membrane reactor
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