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PII: S0376-7388(18)31658-2
DOI: https://doi.org/10.1016/j.memsci.2018.09.003
Reference: MEMSCI16448

To appear in: *Journal of Membrane Science*

Received date: 16 June 2018
Revised date: 30 August 2018
Accepted date: 1 September 2018

Cite this article as: Rasmus S.K. Madsen, Julius Motuzas, James Vaughan, Anne Julbe and João C. Diniz da Costa, Fine Control of NaCl Crystal Size and Particle Size in Percrystallisation by Tuning the Morphology of Carbonised Sucrose Membranes, *Journal of Membrane Science*, https://doi.org/10.1016/j.memsci.2018.09.003

Fine Control of NaCl Crystal Size and Particle Size in Percrystallisation by Tuning the Morphology of Carbonised Sucrose Membranes

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Abstract

This work investigates the morphological features of porous carbon membranes and operation effects for the percrystallisation of NaCl. The carbon membranes were prepared by dip coating of α-alumina tubes in a sucrose solution, followed by a post vacuum-assisted impregnation and carbonisation in an inert gas atmosphere. The carbonisation temperature played an important role, as the highest pore volume and wet contact angle were achieved at the highest carbonisation temperature of 750 °C. In turn, this created hydrophobic carbon membranes delivering the highest water flux of 33 L m^{-2} h^{-1} (NaCl 17.5 wt%) and NaCl flux of 6.9 kg m^{-2} h^{-1}. The solvent (water) and the solute (NaCl) crystals were separated in a single-step in a wet thin-film formed on the permeate face of the membrane under pervaporation conditions, delivering almost pure water (>99%) and dry NaCl crystals. The carbon membrane with the highest water flux delivered the smallest NaCl crystallite sizes, the smaller particle sizes, and the narrowest particle size distribution (< 2 μm). This was attributed to the fast water evaporation rate from the wet thin-film, as crystal growth rate was reduced and NaCl particle aggregation was restricted. A finer control of NaCl crystallite and