Nanocomposite desalination membranes made of aromatic polyamide with cellulose nanofibers: synthesis, performance, and water diffusion study

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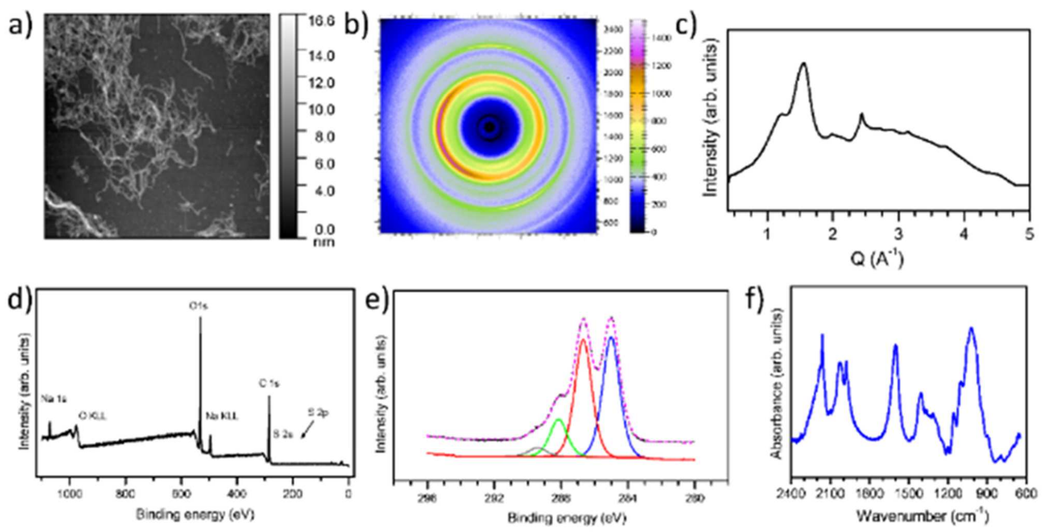
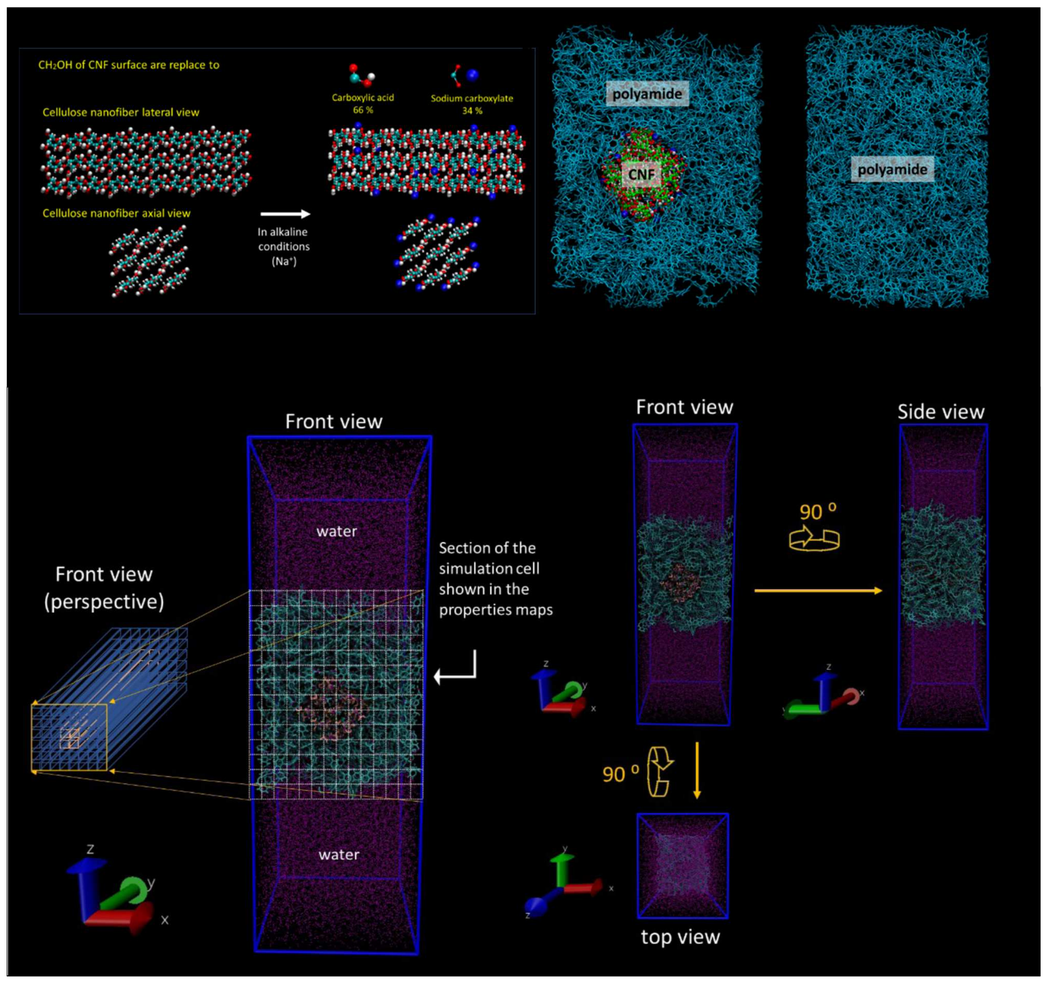
Reverse osmosis membranes of aromatic polyamide (PA) reinforced with a crystalline cellulose nanofiber (CNF) were synthesized and their desalination performance were studied. Tempo-oxidized CNF was used to improve the water permeation rate, antifouling and chlorine resistance properties of the aromatic PA membranes. The synthesis was carried out by dispersing the CNF in the aqueous phase and performing the interfacial synthesis as usual. The presence of sodium carboxylate groups of CNF within the CNF-PA membrane improved the water diffusion rate, while the chlorine-resistance of CNF contributed to improvement of the stability of the membrane against chlorination. The slight decrease in surface roughness and the presence of negatively charged TEMPO-CNF may have also improved the antifouling against negatively charged BSA molecules.

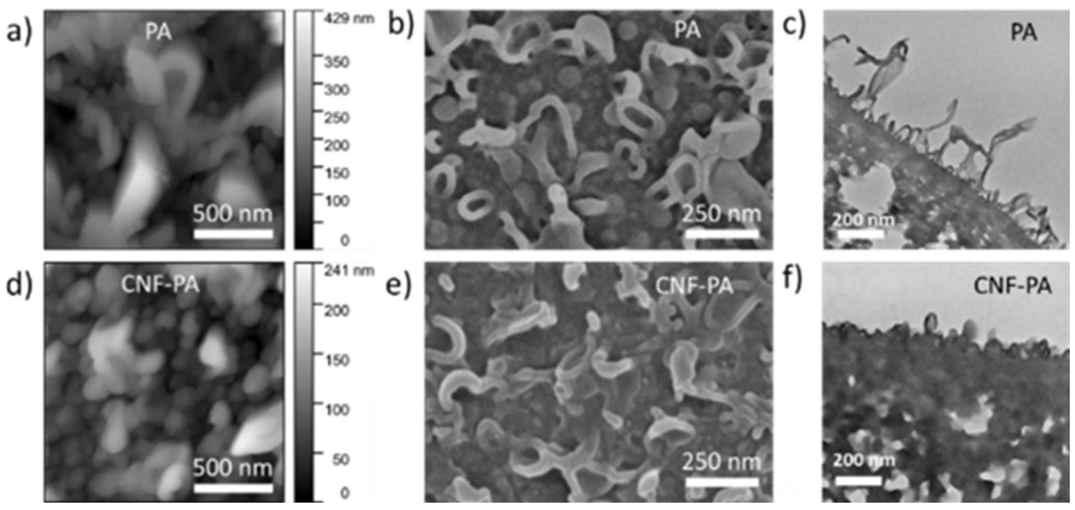
Pure CNF characterization



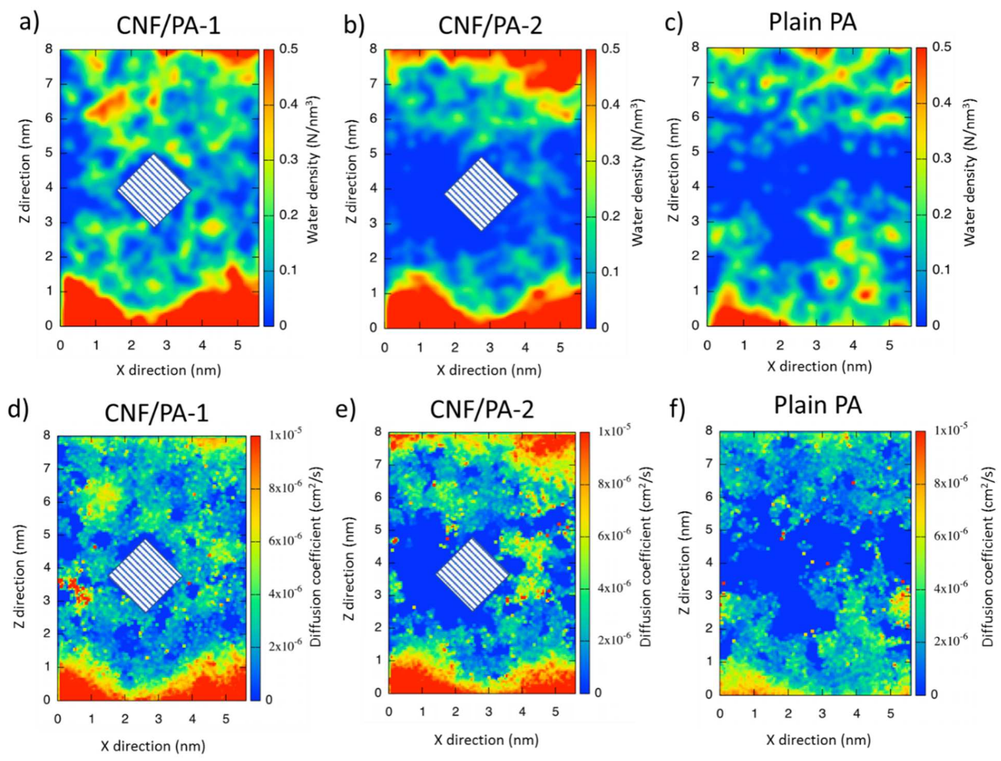
Molecular dynamics study of PA and PA-CNF membranes



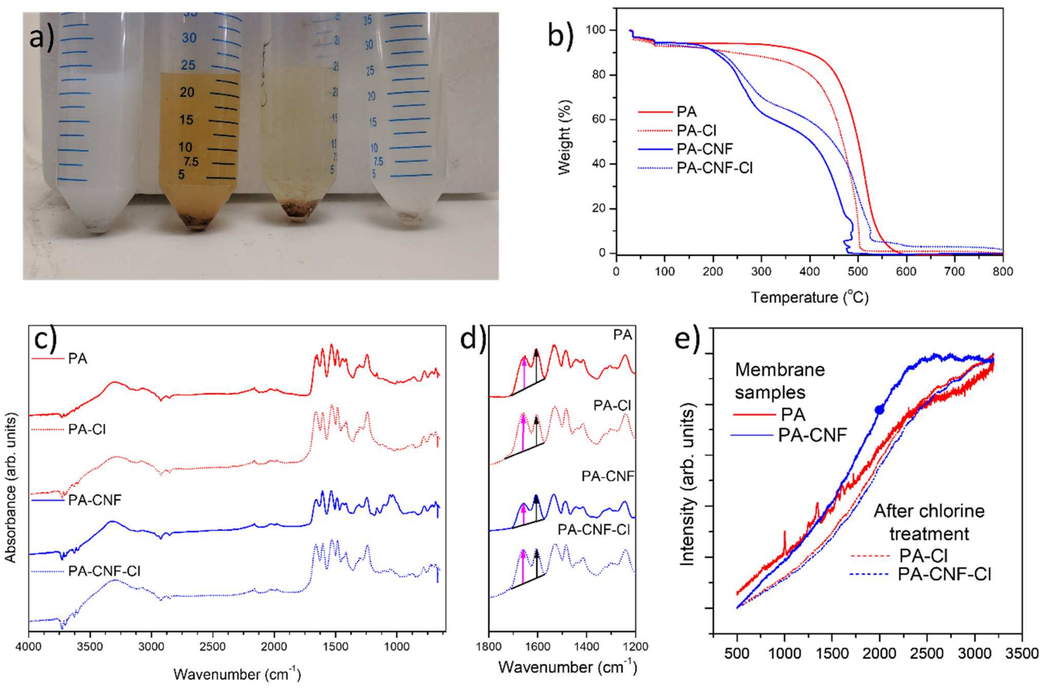
PA and PA-CNF membrane morphology characterization



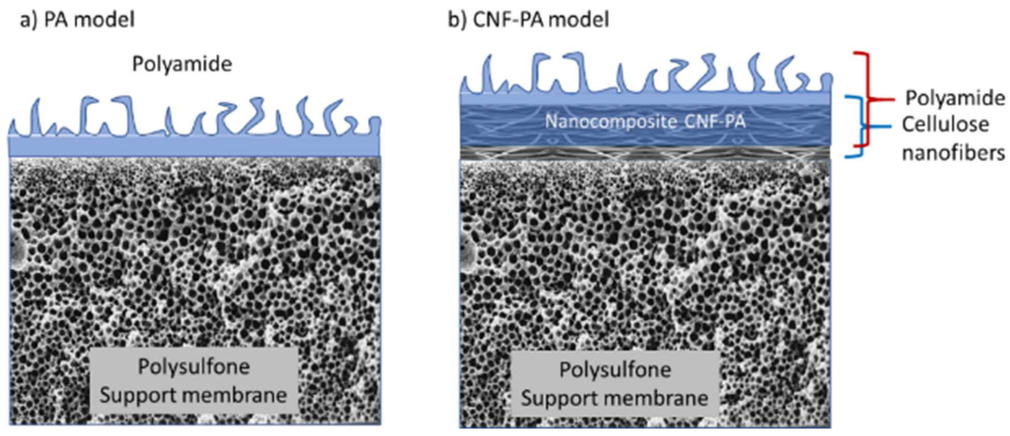
Water density and diffusion coefficients maps of PA and PA-CNF membranes as calculated by molecular dynamics



PA and PA-CNF membranes chlorine resistance study



PA and PA-CNF thin-film composite membranes



Conclusions:

The use of cellulose is an environmentally friendly alternative nanomaterial to improve the properties of polyamide membranes. The nanocomposite cellulose-polyamide membrane shows higher permeability, great antifouling properties, higher chlorine resistance and good salt rejection. The results show that CNF-PA membranes is a material with great potential to be used in reverse osmosis desalination membranes for seawater.

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