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Carbon nanotube/polyamide membranes: a SAXS study

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1. Back ground and research purpose

Multiwalled carbon nanotubes (MWCNT) containing polyamide membranes have shown remarkable chlorine resistance and high water permeation while maintaining a low-salt passage.[1] However, there is no detailed mechanism that allows the high chlorine resistance. Here, we used SAXS to understand changes in the microsctructure of pure PA and PA-MWCNT composite membranes after chlorination treatment.

2. Experimental

Pure polyamide samples were prepared by interfacial polymerization. Briefly, the aqueous phase was prepared by dissolving the m-phenylendiamine in water (2 wt%) and trimesoylchloride (0.1 wt %) was dissolved in hexane to prepare the organic phase. Then, these solutions were mixed in a beaker and stirred energically. A transluscent precipitate of pure polyamide was separated by centrifugation, washed with methanol and dried, resulting in a white PA sample. The PA-MWCNT composite was prepared similarly but in this case, 0.4 % wt of MWCNTs were added in the aqueous phase. The resulting nanocomposite was a dark gray material.

3. Results and discussions

Pure PA and PA-MWCNT samples showed higher scattering in the 0.5 to 5 nm^{-1} region, as shown in Fig. 1. This is consistent with the development of a microporosity upon chlorination treatment and has been reported for polyamide samples. The slightly higher scattering of the composite sample is attributed to the presence of electronic heterogeneity that arises from the presence of carbon nanotubes, which are a dominant effect over the pores generated by the chlorine treatment. Analysis of hydrated and dry samples also shows that pure polyamide samples are more prone to water adsorption which could facilitate their egradation due to a facilitated path for the chlorine ions to the inner part of the membrane. 2D-WAXD is also consistent with the data shown by the SAXS. Comparative analysis of 2WD also shows the scattering peaks due to the MWCNTs.

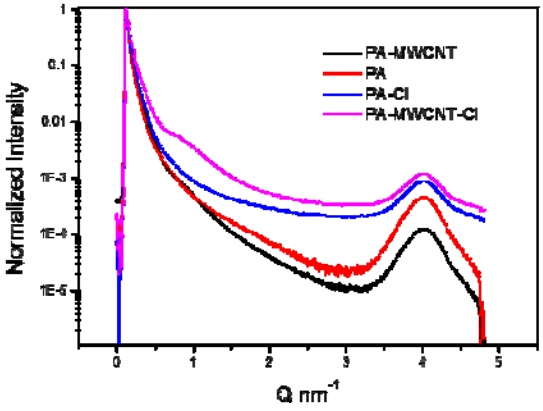

Fig. 1. SAXS scattering vectors of polyamide samples before and after Chlorine treatment

4. References

1. Inukai *et al.* High-performance multi-functional reverse osmosis membranes obtained by carbon nanotube·polyamide nanocomposite. *Scientific Reports*, (2015) 5, 13562.