The role of graphene in membrane distillation technology towards portable desalination devices

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Abstract

The scarcity of freshwater resources is a critical issue in many countries around the world and seawater desalination is considered one of the most sustainable way to address this issue. [1,2]

In remote areas where well-established plants for desalination, *e.g.*, reverse osmosis (RO), are not practicable because they require high-cost infrastructures, pipelines and transport, [3] developing an affordable and portable device to produce clean water can be a promising solution for people who are living in water scarcity.

Among the desalination techniques, membrane distillation (MD) technology is emerging as a convenient alternative to RO, due to its low-pressure (~1 bar in MD vs 50-80 bar in RO) and temperature (25°C-45°C) operating conditions [4,5] and the consequent possibility to be powered by natural and renewable energy sources. Nevertheless, MD technology is not robust enough to be implemented at the industrial level, being mainly limited by low trans-membrane fluxes (few $Lm^{-2}h^{-1}$ under a flow rate of 100 $mLmin^{-1}$) and partial wetting resistance. [5] We have recently designed a graphene-based composite membrane, showing enhanced diffusion properties and total salt rejection, compared to the pristine membrane, in a typical MD process. [6]

We are now targeting the design and realization of advanced membranes at large scale. This paves the way to the industrialization of the MD process. To this end, we are currently working to the prototyping and future marketing of a portable device for seawater desalination based on graphene membrane, while investigating the effect of other two-dimensional crystals on trans-membrane fluxes in the MD process.

References

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