chem2Dmat
August 31 - September 03, 2021 • Bologna, Italy
European Conference on Chemistry of Two-Dimensional Materials

An explorative study on the potential of 2D materials-based membranes for enhanced water desalination processes

Frappa M., Drioli E., Gugliuzza A.
Institute on Membrane Technology - CNR-ITM, via P. Bucci 17C, 87036 Rende (CS), Italy
m.frappa@itm.cnr.it

The use of 2D materials has been demonstrated to have a great impact on the research dedicated to water desalination [1,2]. In this work, we discuss how the inclusion of 2D materials in hydrophobic porous PVDF membranes improves the fluxes while a better quality of water can be achieved. Also, we demonstrate how salts can be recovered from hypersaline solutions; crystals with somewhat uniform size and well-shaped geometry can be obtained. Specifically, we discuss the fabrication of new-concept exfoliated few layers materials-enabled membranes aimed at enhancing the performance of two eco-sustainable technologies such as Membrane Distillation (MD) and Membrane Crystallization (MCr)[2-4]. We assess how water is diffused through the membrane when applying a difference of temperature across the membrane. This diffusion can be amplified in presence of a suitable loading of few layers 2D materials. Larger water fluxes are thus produced. Assisted water uptake causes also quicker water sequestration from water-salt clusters reaching supersaturation conditions in a shorter time. As a subsequent effect, rapid formation of nuclei and controlled growth of crystals are obtained [3]. Herein, a summary of the most interesting achievements is given and the behaviour of 2D materials functional membranes is described as a function of chemical composition and salt concentration as well as running conditions selected for membrane operations. This study provides new insights about the promising role of 2D materials in water desalination through the implementation of enhanced eco-sustainable membrane distillation and membrane crystallization processes.

Acknowledgements

We acknowledge financial grant from 'the Italian Ministry of Foreign Affairs and International Cooperation' within the framework of the Great Relevance International Project Italy (MAECI)-China (NSFC) 2018-2021 - New Materials, with particular reference to Two-dimensional systems and Graphene (2DMEMPUR)

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Figure

Figure 1: Inclusion of 2D flakes in PVDF-based membrane for desalting highly saline waters and recovery salt crystals [3]