Ceramic Biomimetic Coatings to Boost PVDF Membrane Performance in Treating Low Surface Tension Wastewater Streams

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Introduction. This study addresses the pore wetting risk associated with current Membrane Distillation technologies (MD) in the presence of volatile organic compounds in feed aqueous solutions [1]. By doing so, it presents a sustainable solution inspired by biomimicry, which contributes to the ongoing endeavors aimed at ensuring access to clean water while mitigating the environmental impact of industrial processes [2]. A comparison of ceramic superhydrophobic biomimetic coatings, renowned for their water-repellent properties in harsh environments [3][4][5], is here presented as potential solutions to alleviate fouling and scaling while enhancing efficient water vapor transport during the membrane distillation process with polyvinylidene fluoride (PVDF) membrane contactors. This work has been done within the UE project MEASURED (www.measured-project.eu) coordinated by the University of Eindhoven (TU/e).

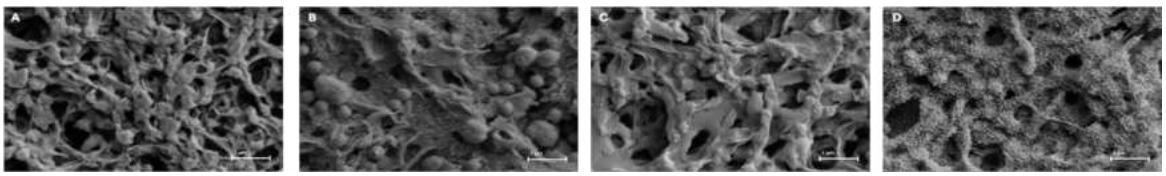

Figure 1. SEM micrographs of the PVDF surfaces before (A) and after the deposition of the coatings (B-C-D).

Experimental/methodology. The PVDF membranes were supplied by CNR-ITM and the company GVS. Both were coated using the procedures developed by CNR-ISSMC. Characterization was conducted at CNR (ITM, ISSMC) and the University of Calabria. It includes morphology analysis (SEM, AFM), determination of pore size, thickness, porosity, and surface energy of both coated and uncoated membranes. Additionally, contact angles were measured using real industrial wastewater mixtures provided by GVS Company.

Results and discussion. In our study, we have devised a straigthforward and scalable dip-coating process to fabricate omniphobic coatings with a hierarchical micro/nanostructures surface texture on flexible PVDF membrane substrates of different pore-sizes. Our optimization efforts have resulted in a substantial reduction of the surface energy to the magnitude of a few mN/m with the aim to identify the most suitable candidate for membrane distillation application within a pilot plant setting.

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