The advent of photothermal assisted membrane crystallization

S. Santoro[1], A. H. Avci[1], M. Aquino[1], A. Politano[2], C. Cantalini[2] and E. Curcio[1]

[1]*Department of Environmental Engineering, University of Calabria, P. Bucci 45A, 87036 Arcavacata di Rende, Italy*

[2] *Department of Physical and Chemical Sciences, University of L'Aquila, via Vetoio, 67100 L'Aquila (AQ) Italy*

sergio.santoro@unical.it

Conversion and exploitation of solar energy is a decisive strategy to alleviate the global energy crisis closely linked to the environmental challenges. In this scenario, the advent of photothermal materials able to efficiently convert the solar radiation into heat have gained more attention by fundamentally modernizing the concept of heat harvesting, particularly in innovative evaporation configurations opening unprecedented horizons in futuristic applications.
One of them is Membrane Distillation (MD), a hybrid thermal/membrane technology hindered by intrinsic thermal polarization phenomenon compromising the productivity and the feasibility of the process [1]. Our ground-breaking studies demonstrated the tremendous advantages of the immobilization of photothermal nanoparticles into polymeric membranes employed in seawater desalination via MD process [2]. Definitively, photothermal self-heating membranes ensured a drastic reduction of the energy input required for water evaporation coupled with a radical augment in the freshwater productivity.
Herein, we firstly explored the potential of photothermal materials in the recovery of valuable raw materials via solar-driven photothermal Membrane Distillation-Crystallization (MCr). Pioneering photothermal membranes were prepared by the embodiment of nanometric blackbodies able to ensure an effective *in-situ* solar light-to-heat conversion and a subsequent increase of the evaporation rate of water displaced on the membrane surface. This effect was exploited to exceed the supersaturation in brine inducing the crystallization of a liquescent salt.
Definitively, the cutting-edge concept of the solar-driven photothermal M-Cr opens the door to a sustainable mining from brine.

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