

PHOTOCATALYTIC COMPOSITE MEMBRANES FOR WATER TREATMENT: RESULTS, LIMITATIONS, AND NEW INSIGHTS

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Results

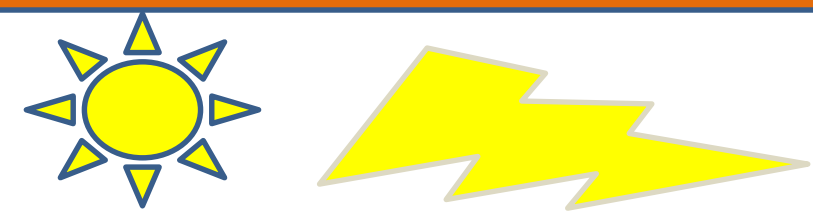
Photocatalytic membranes for degradation of **DYES** from **WATER** (initial concentration; removal efficiency (%); light source; exposure time.)

PAN/GO-ZnO	Methylene blue	10 mg/L; 98%; visible light; 70 min.	Mottaleba MM, et al. <i>J Mech Behav Biomed Mater.</i> 2019; 96:118-24.
PVDF/TiO ₂ -SnO ₂	Rhodamine B	10 mg L ⁻¹ ; 91.84%; UV light irradiation; 270 min.	Hong W, et al. <i>New J. Chem.</i> , 2021, 45, 2631-2642
PMMA/TiO ₂	Methyl orange	10 mg/L MO; UV illumination; 50 min.	Li Y, et al. <i>J Colloid Interface Sci.</i> 2017; 508:500-07.
CA-PU/ZnO	Reactive Red 11	98%; 40 min; UV light irradiation; neutral pH.	Rajeswari A, et al. <i>Chem. Eng. J.</i> , 2017;313: 928-37.
PA6/TiO ₂	Remazol Black B	3 mg/L; 80 %; UV (365 nm); 240 min.	Blanco M, et al. <i>Polymers (Basel)</i> . 2019; 11:1-11.
Chitosan/ZnO	Crystal violet	25-100 microM; ~100%; Tungsten lamp; 300 min.	Abarna B, et al. <i>J Mater Sci Mater Electron.</i> 2019; 30: 21355-68.



Photocatalytic membranes for degradation of **PHARMACEUTICALS** from **WATER** (initial concentration; removal efficiency (%); light source; exposure time.)

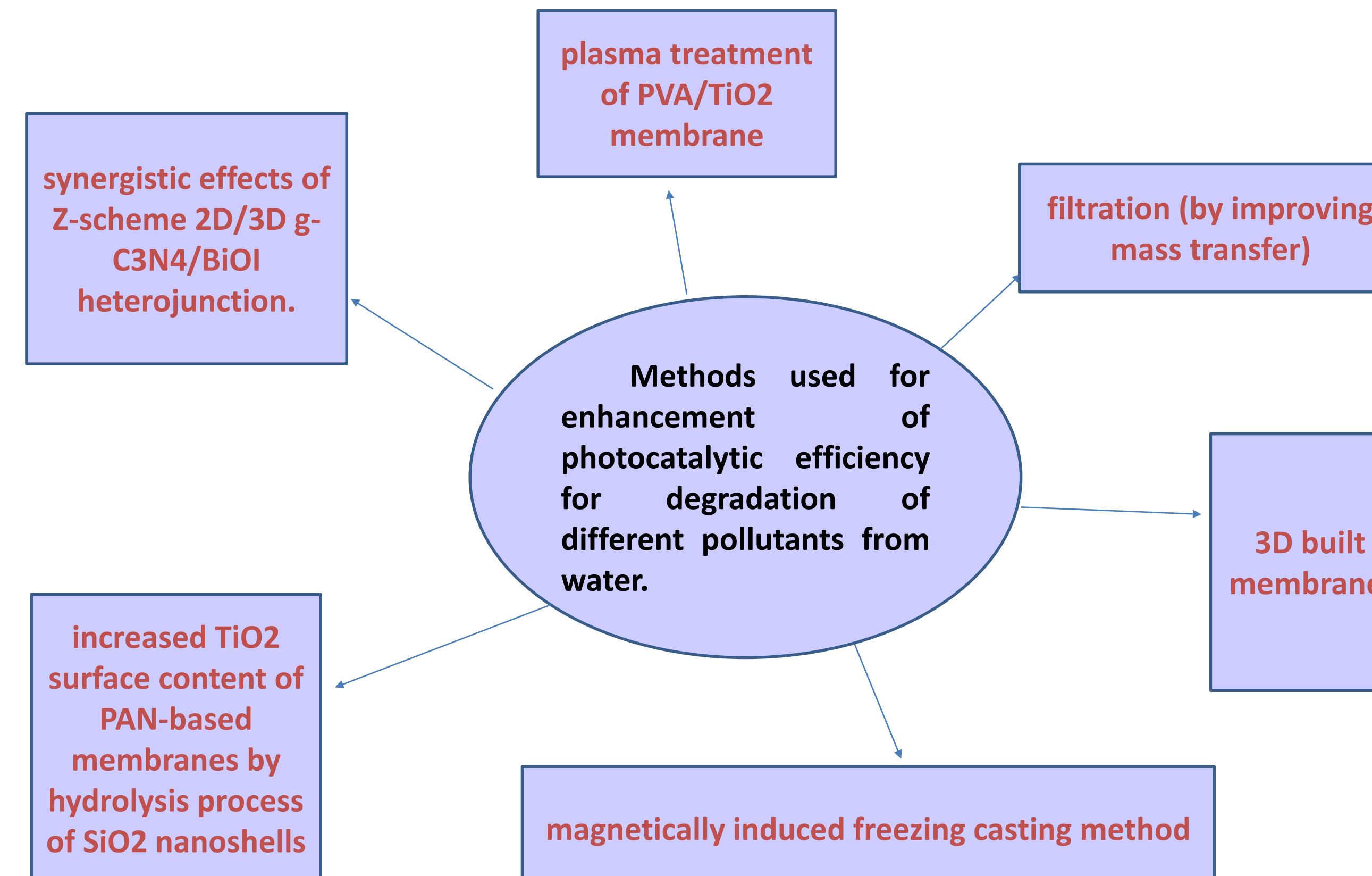
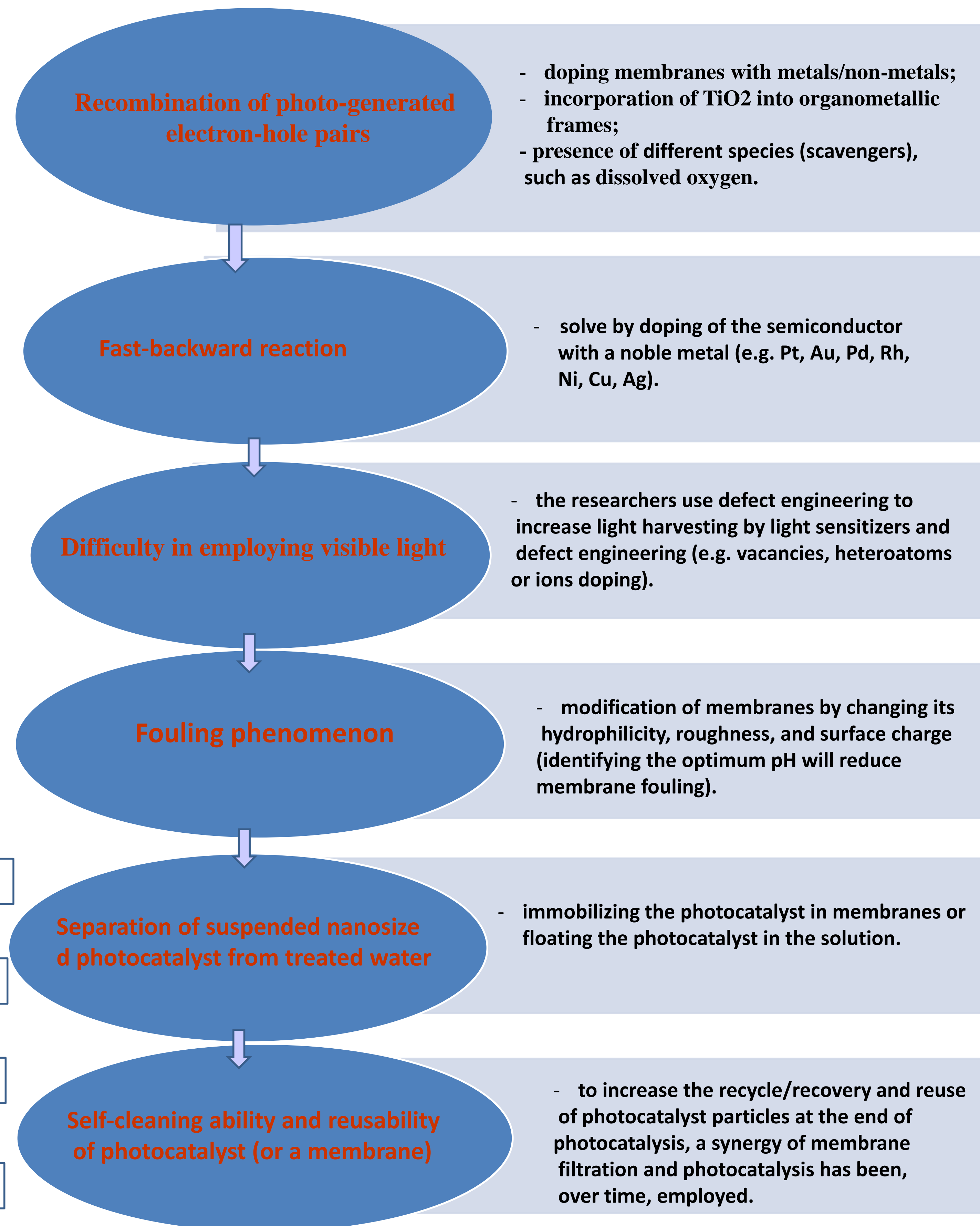
PVDF/ZnIn ₂ S ₄	tetracycline	0.45 g; 92%; visible light; 36 h.	B Gao, et al. <i>J Photochem. Photobiol. A: Chem.</i> 364, 2018; 732-739.
Zn-Co-LDH/biochar	gemifloxacin	92.7%; UV light irradiation; 80 min.	P Gholami, et al. <i>J. Hazard. Mat.</i> , 382, 2020, 121070.
TiO ₂ /graphene oxide/Fe ₃ O ₄	amoxicillin	27 wt% -TiO ₂ -Fe ₃ O ₄ ; 90%; visible light; 120 min.	Q Li, et al. <i>J. Hazard. Mat.</i> , 373, 2019, 437-446.
PSF/Cu ₂ O	ibuprofen	86%; visible light; 60 min.	R Singh, et al. <i>Sep. Purif. Technol.</i> , 2018, 2-33.
PVDF-HFP/Ag-TiO ₂	norfloxacin	80.7%; visible light; 300 min.	H Salazar, et al. <i>Chemosphere</i> , 2020, 250, 1-30.



Photocatalytic membranes for degradation of **PESTICIDES** from **WATER** (initial concentration; removal efficiency (%); light source; exposure time)

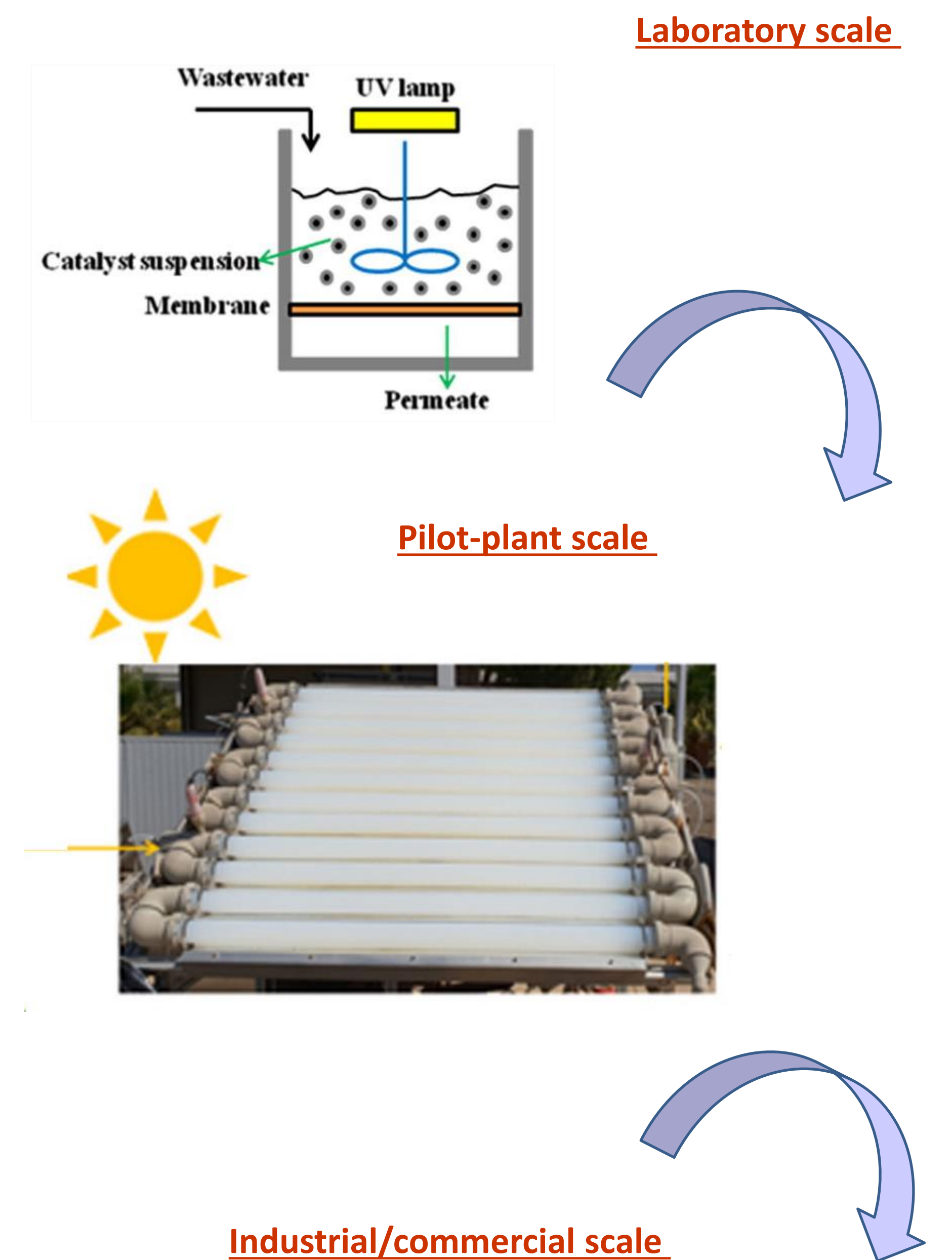
rGO/TiO ₂	methomyl	complete degradation; 25 min irradiation.	G. Luna-Sanguino, et al. <i>Sci. Total Environ.</i> , 737, 2020, 140286.
TiO ₂ /SiC foams	paraquat	UV-C (254 nm); 91%; 3h.	C. Marien, et al. <i>J. Hazard. Mat.</i> 370, 2019, 164-171.
PVDF/PDA-BiOCl _{0.875} Br _{0.125}	Roxarsone	~100%; visible light; 3h.	J Zhou, et al. <i>Chem. Eng. J.</i> 402, 2020, 126048.
PES/Co/TiO ₂	2,4-dichlorophenol	50 mg; 53%; visible light irradiation; 120 min.	N Hoseini, et al. <i>J. Water Process Eng.</i> , 17, 2017, 124-134.

Limitations /Solutions



New insights

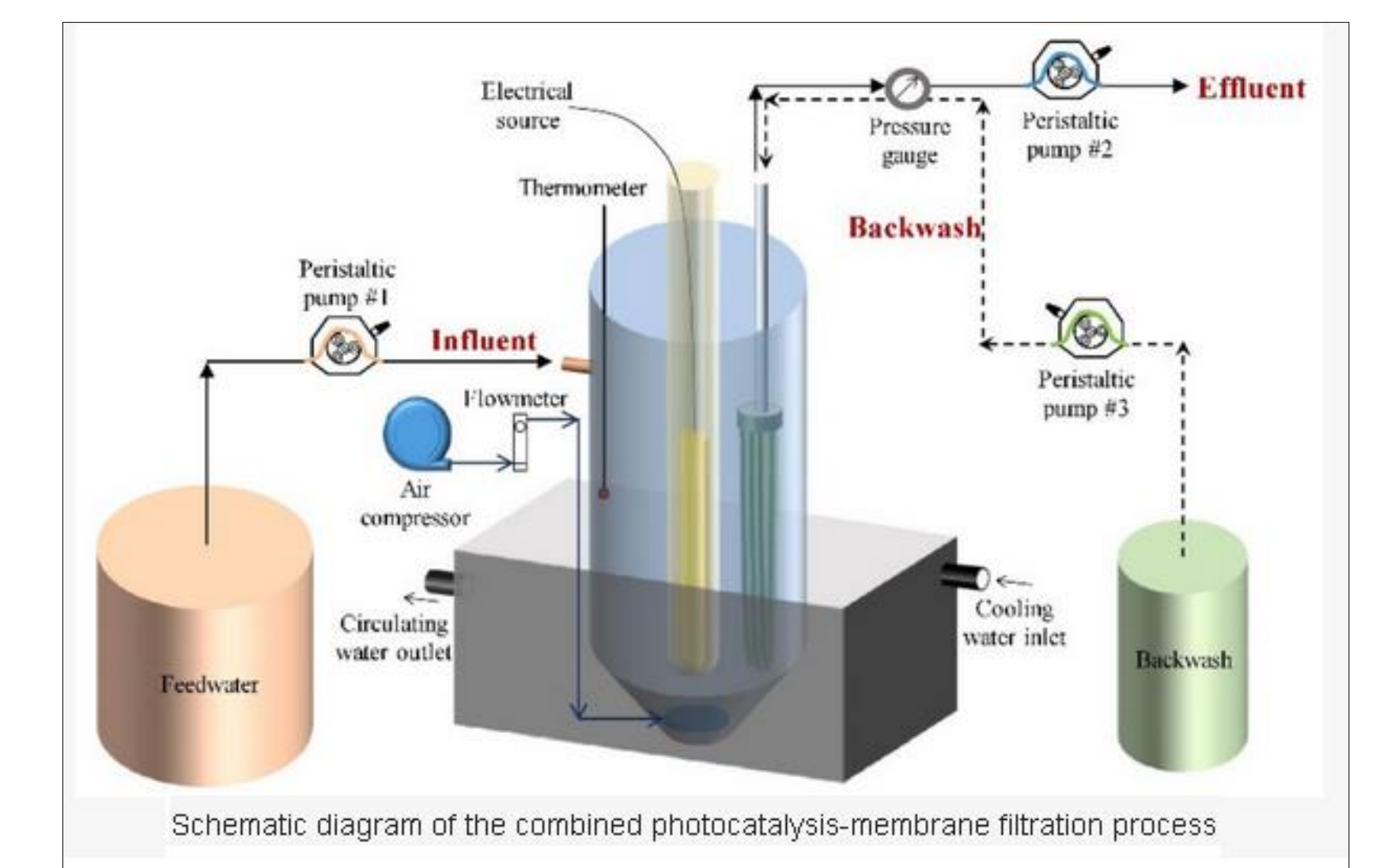
From laboratory scale to pilot-plant and commercial scale photocatalytic membranes



The implementation of photocatalytic membranes at large-scale (industrial / commercial level) have been scarce due to:

- low photocatalytic activity, in particular, under visible and solar illumination;
- associated economic, energy efficiency, and environmental impacts;
- efforts necessary to design and develop the photocatalytic reactor;

(R. Molinari, C. Lavorato, P. Argurio, The Evolution of Photocatalytic Membrane Reactors over the Last 20 Years: A State of the Art Perspective, *Catalysts* 2021, 11(7), 775; <https://doi.org/10.3390/catal11070775>).



(Wang, Q. et al. Submerged membrane photocatalytic reactor for advanced treatment of p-nitrophenol wastewater through visible-light-driven photo-Fenton reactions. *Sep. Purif. Technol.* 2021, 256, 117783)