

In-Situ H₂O₂ Cleaning for Fouling Control of Manganese-Doped Ceramic Membrane Through Confined Catalytic Oxidation Inside Membrane

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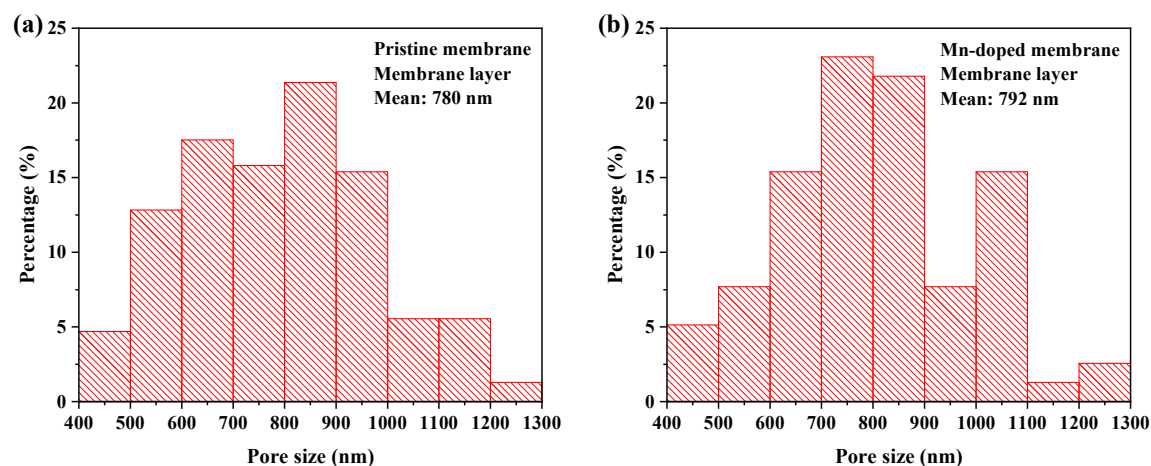


Figure S1. The pore size distribution of the (a) pristine and (b) Mn-doped membrane layers.

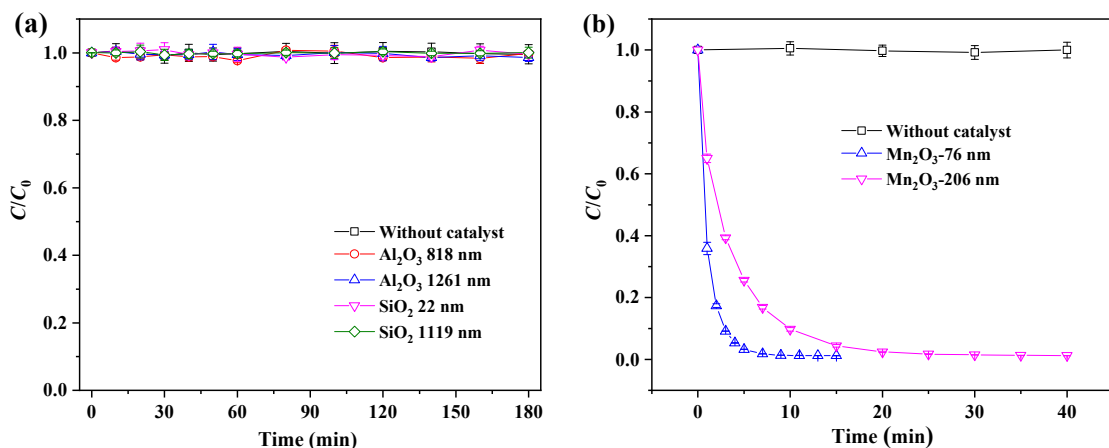


Figure S2. H₂O₂ decomposition catalyzed by commercial metal oxide particles at neutral pH. (a) Al₂O₃ or SiO₂; (b) Mn oxides. (Operating conditions: $C_0 = [\text{H}_2\text{O}_2]_0 = 1 \text{ mM}$; C is the concentration of H₂O₂; $M_{\text{metal oxides}} = 1 \text{ g/L}$ except $M_{\text{Mn oxides}} = 0.05 \text{ g/L}$; initial pH = 6.8-7.0)

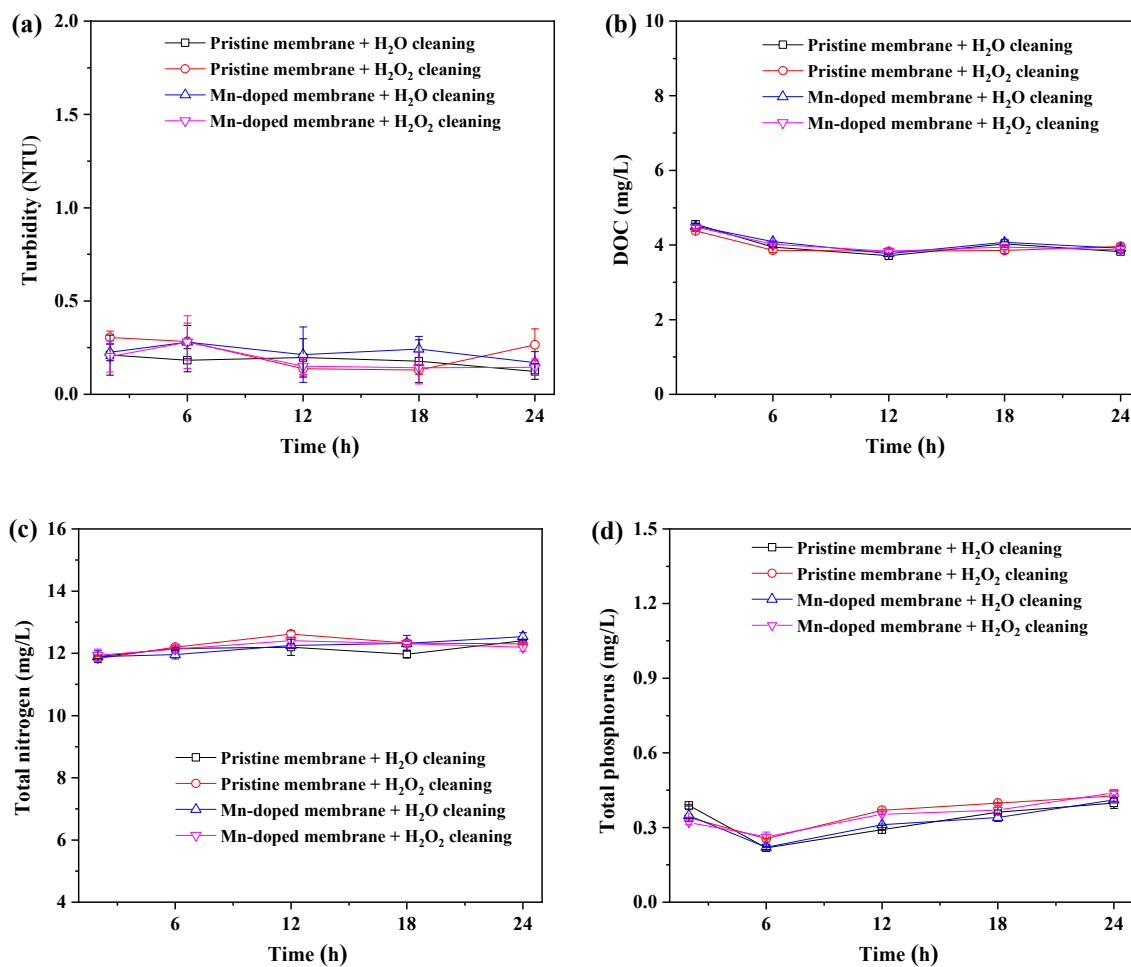


Figure S3. Water quality of the permeate when membranes were *in-situ* cleaned with H₂O or H₂O₂. (a) Turbidity, (b) DOC, (c) total nitrogen, (d) total phosphorus.

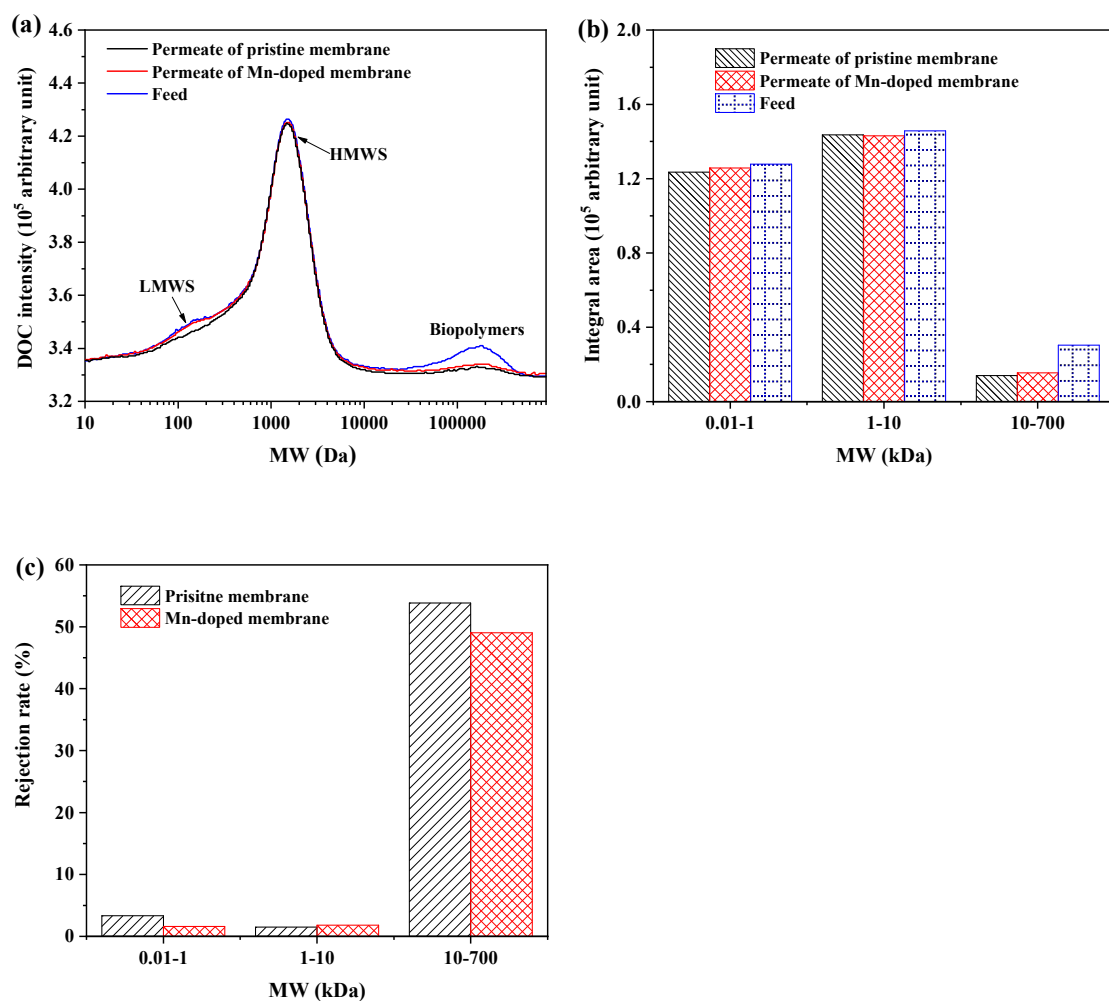


Figure S4. MW distribution of DOC in the feed and permeates during membrane filtration at flux of 60 LMH without backwash. (a) MW distribution of DOC; (b) integral area of different MW components; (c) rejection rates of different MW components by membranes.

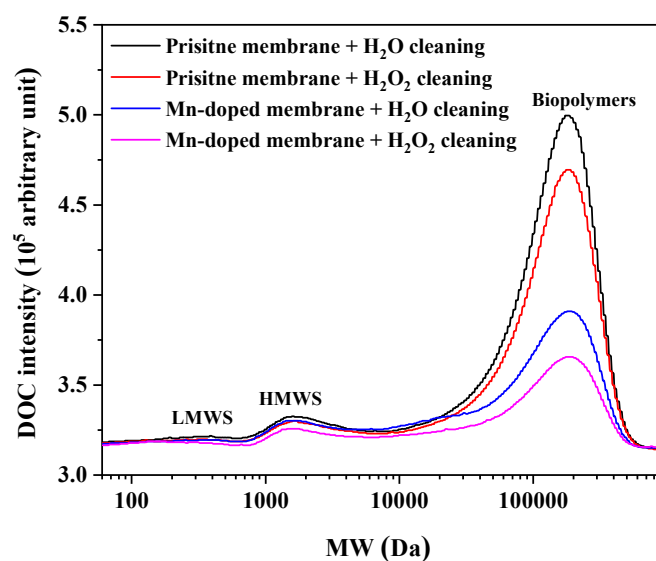


Figure S5. MW distribution of DOC in the physically removable fouling layer after 24 hours filtration.

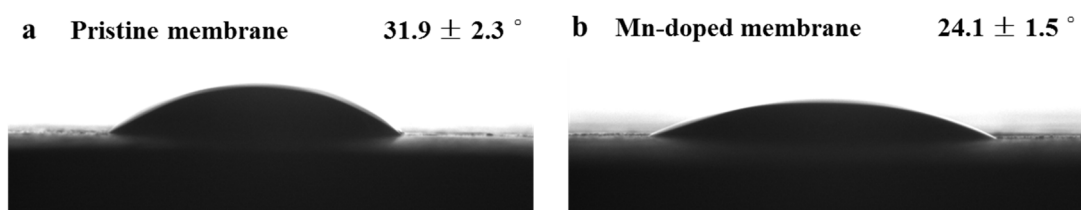


Figure S6. Pure water contact angles of the pristine (a) and Mn-doped membranes (b).

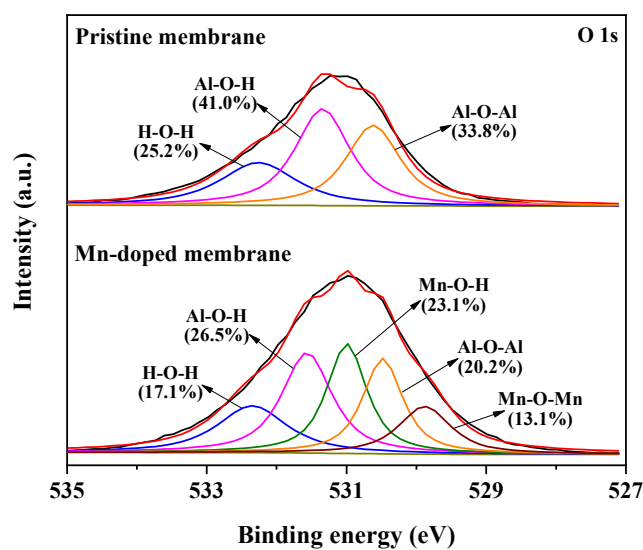


Figure S7. XPS spectra of O 1s of the pristine and Mn-doped ceramic membranes.

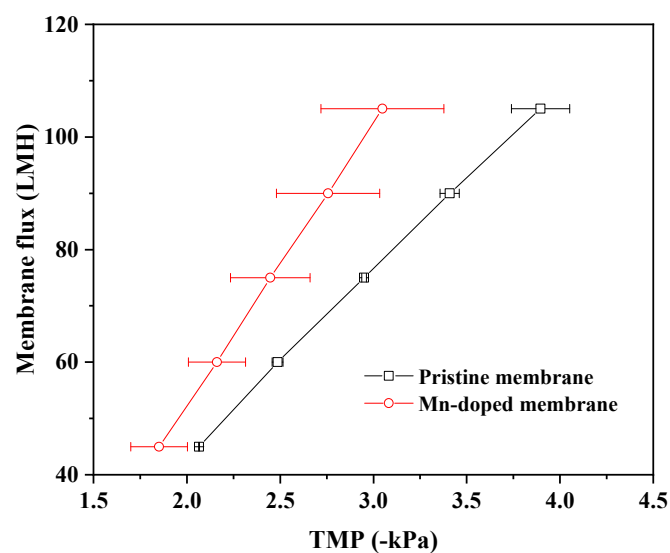


Figure S8. Pure water permeabilities of the pristine membrane and Mn-doped membrane.

Table S1. Mixed liquor properties after membrane filtration.

Mixed liquor properties	Pristine membrane + H ₂ O cleaning	Pristine membrane + H ₂ O ₂ cleaning	Mn-doped membrane + H ₂ O cleaning	Mn-doped membrane + H ₂ O ₂ cleaning
DOC (mg/L)	5.5 ± 0.2	5.5 ± 0.1	5.7 ± 0.3	5.6 ± 0.2
MLSS (g/L)	7.2 ± 0.1	7.1 ± 0.2	7.1 ± 0.2	7.0 ± 0.1
SV ₃₀ (%)	39.0 ± 1.4	38.8 ± 1.8	39.3 ± 1.1	39.1 ± 0.6
Zeta potential (mV)	-12.1 ± 0.8	-12.0 ± 0.7	-12.1 ± 0.3	-11.9 ± 0.3
SOUR (mg O ₂ /(g MLSS*min))	0.1338 ± 0.0110	0.1326 ± 0.0008	0.1340 ± 0.0122	0.1432 ± 0.0025
pH	6.9 ± 0.1	7.0 ± 0.1	6.9 ± 0.1	7.1 ± 0.1