Table S1. Comparative analysis of the developed CD-based membranes against representative conventional photocatalytic or benchmark membrane systems reported in the literature.

Membrane system	**Active component / type**	**Target / condition**	**Reported performance**	**Antibacterial or self-cleaning feature**	**Comparative note vs. this work**	REF
This work: PVA/PAA-CDs	Green-synthesized CDs in hydrophilic PVA/PAA matrix	MB, 2–10 ppm, natural solar irradiation, static contact	Rapid discoloration from the first 24 h; near-complete visual removal by day 7; COD removal close to 100% during the first week and ~94% after 4 weeks; antibacterial activity >97% at 24 h; under combined MB + light conditions, ~92% inhibition at 24 h	Yes, dual photocatalytic + antibacterial performance	Advantage: dual-function under natural sunlight and a biodegradable/biocompatible matrix. Limitation: slower time scale than highly optimized UV/visible-light TiO_2 systems.	This work
This work: PPSU-CDs	Green-synthesized CDs in hydrophobic PPSU matrix	MB, 2–10 ppm, natural solar irradiation, static contact	Significant discoloration from day 3; transparent solution and membrane by day 7; COD removal ~100% in weeks 1–2 and ~82% by weeks 3–4; antibacterial activity >97% at 24 h; under combined MB + light conditions, ~90% inhibition at 24 h	Yes, dual photocatalytic + antibacterial performance	Advantage: dual function with a chemically robust matrix; lower dark adsorption than PVA/PAA-CDs but better structural robustness.	This work
PVA/PAA@PDA membrane	Polydopamine-coated electrospun PVA/PAA	Methyl blue adsorption	>93% removal within 30 min; maximum adsorption capacity 1147.6 mg g^{-1}	Recyclable adsorbent	Strong fast adsorption benchmark, but not photocatalytic and no antibacterial function reported.	1
rGO/TiO_2-PPSU UF membrane	Conventional TiO_2-based hybrid membrane with rGO	Organic pollutants under visible light	Reported as having efficient visible-light-driven photocatalytic degradation plus improved antifouling/self-cleaning behavior	Self-cleaning / antifouling reported	Good benchmark for conventional visible-light photocatalytic PPSU systems, but the abstracted source does not report simultaneous antibacterial performance.	2
PSF–Ag/CQDs membrane	Polysulfone membrane with Ag/CQDs nanofiller	Tartrazine dye removal	Enhanced dye-removal performance and improved membrane properties	Not presented as dual antibacterial + photocatalytic MB platform in the	Useful CQD-based benchmark, but focused on dye-removal optimization rather than simultaneous MB degradation and antibacterial action.	3

				abstracted source		
CS-PEG-TiO_2 membrane	Chitosan/PEG/TiO_2 photocatalytic filtration membrane	MB filtration	99.4% MB elimination during filtration	Fouling observed during operation	Very high removal benchmark, but the mechanism is strongly tied to filtration/rejection and fouling remained significant; not presented as a dual antibacterial system.	[4]
TiO_2/MXene UF membrane	Conventional TiO_2-based photocatalytic UF membrane	Protein fouling / E. coli under UV	Flux recovery ratio of 80% under UV; >95% resistance against *E. coli*	Yes, antibacterial and antifouling under UV	Strong antibacterial/self-cleaning benchmark, but UV-dependent and not reported for MB degradation in the cited source.	[5]

Figure S1 shows the TEM micrograph of the individual CDs. It should be noted that they are agglomerated by the evaporation process to obtain them in powder form, which is why they appear larger.

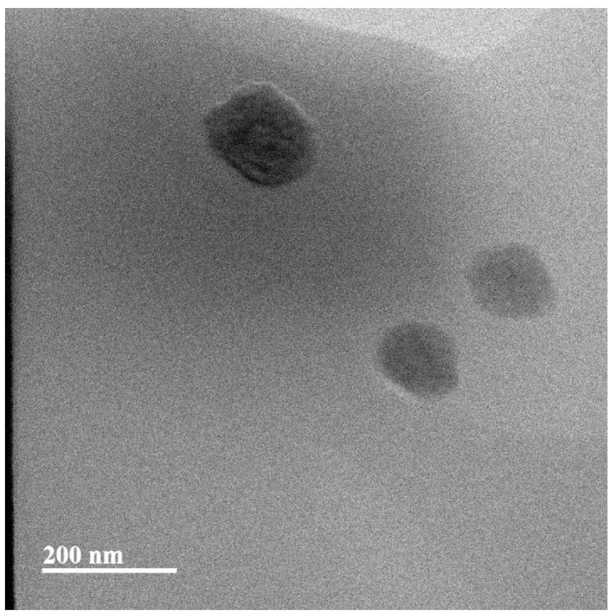

Figure S1. TEM micrograph of the individual CDs

Recyclability test: Membrane PVA/PAA-CDs reuse 5 different times after 7 days of degradation

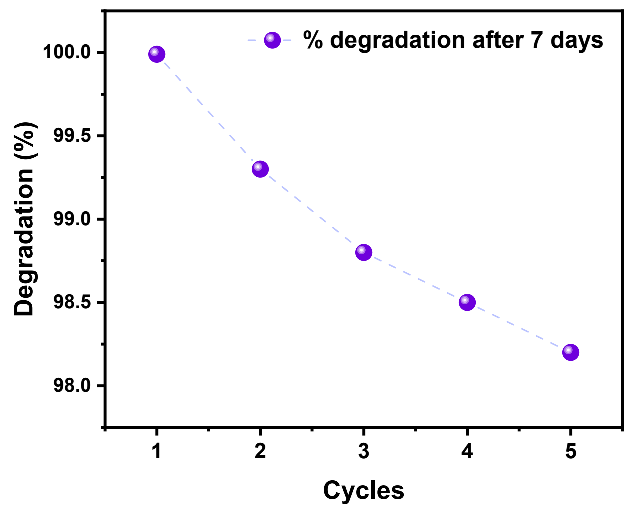

Figure S2. Membrane reuse after the photodegradation test

Table S2. Absorbance data after photodegradation using a pseudo-first order model based on the Langmuir-Hinshelwood approach

PVA/PAA-CDs				
t(h)	**A_0**	**A_t**	**ln (A_0/At)**	**Degradation efficiency (%)**
0	0.7510	0.7510	0	0
24	0.7510	0.2717	1.017	63.82
48	0.7510	0.0342	3.089	95.44
72	0.7510	0.0194	3.656	97.41
120	0.7510	0.0045	5.11	99.40
PPSU-CDs				
t(h)	**At**	**At/A0**	**ln (A_t/A_0)**	**Degradation efficiency (%)**
0	0.7510	0.7510	0	0
24	0.7510	0.4175	0.588	44.40
48	0.7510	0.0683	2.398	90.90

72	0.7510	0.0088	4.446	98.82
120	0.7510	0.0014	6.285	99.813

Straight adjustment

$y = kt + b$

PVA/PAA-CDs

y=0.0434t+0.2844

$K=0.0434h^{-1}$

R^2= 0.9470

PPSU-CDs

y=0.0562t+0.2254

$K=0.0562h^{-1}$

R^2= 0.9715

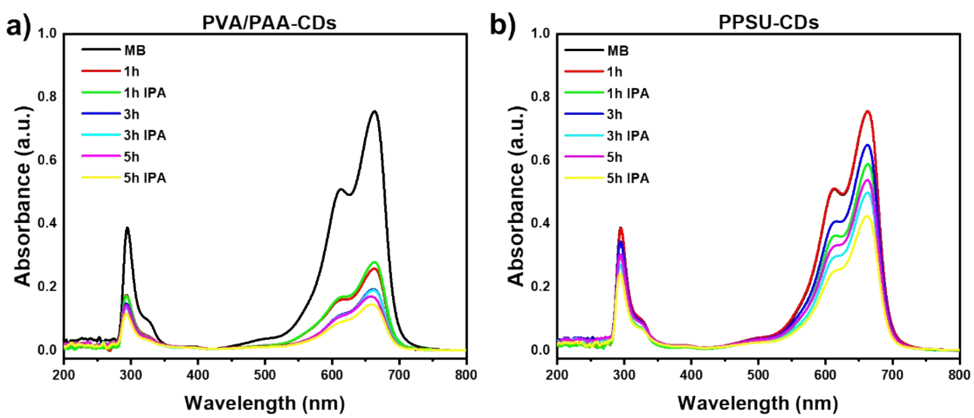

Figure S3. Spectra UV of free radical scavenging using isopropanol

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