Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Supplementary information

One-step Biosynthesis of Bilayered Graphene Oxide Embedded Bacterial Nanocellulose Hydrogel for a Versatile Photothermal Membrane Applications

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***Summary**: Total 11 pages with 9 figures and 2 tables*

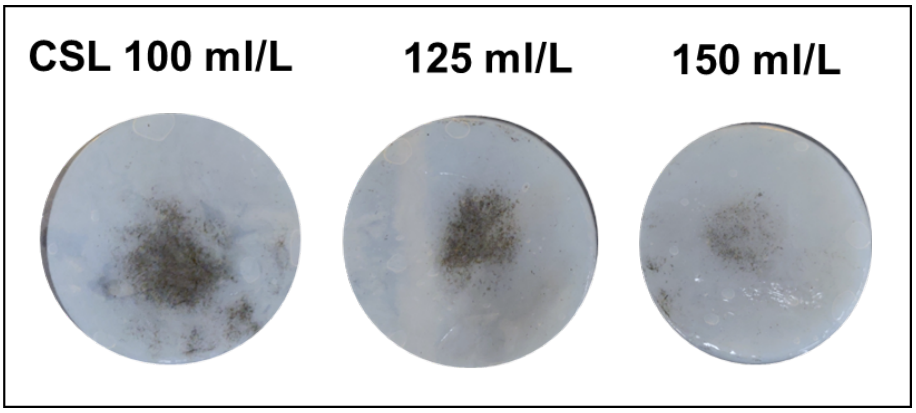

Fig. S1. Photographic images of BNC hydrogels obtained with the growth medium supplemented with CSL of 100, 125, 150 mL/L and 0.05 wt% of GO.

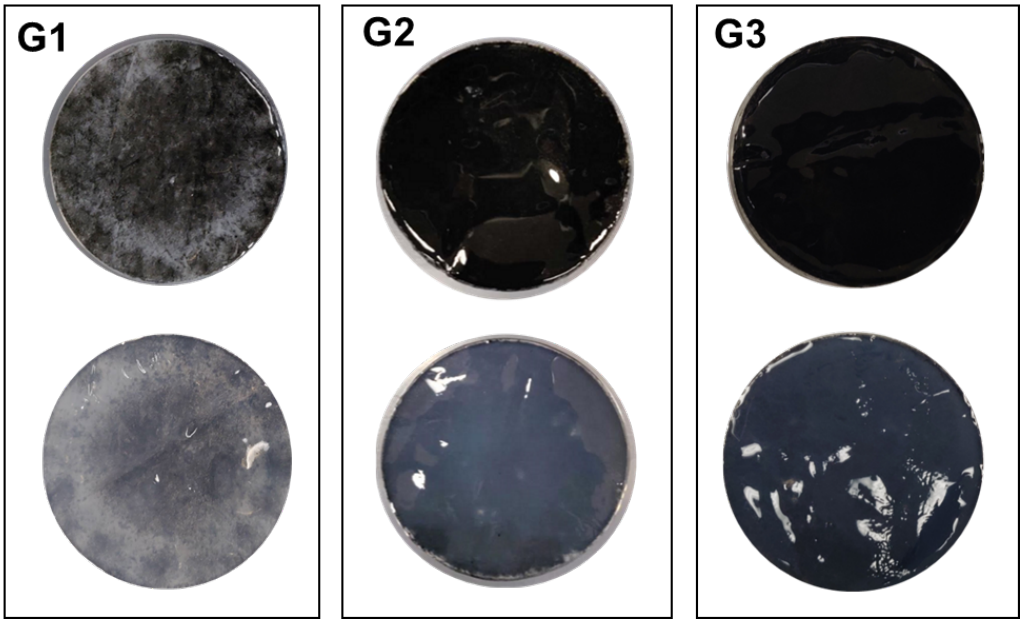

Fig. S2. Photographic images of rGO/BNC:BNC hydrogels obtained with the growth medium supplemented with GO of 0.025 (G1), 0.05 (G2), 0.075 (G3) wt% and CSL of 20 mL/L.

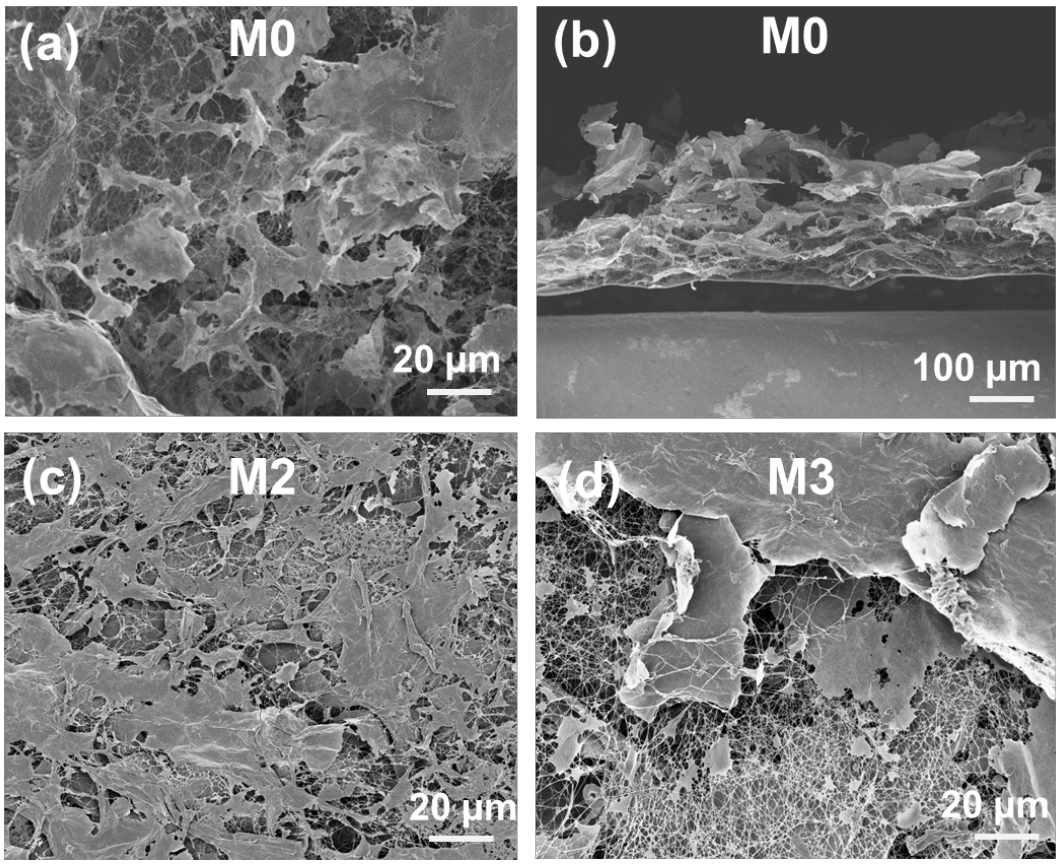

Fig. S3. SEM morphology of rGO/BNC membrane (a) top surface and (b) cross section, top surface morphology of rGO/BNC:BNC membranes (c) M2 and, (d) M3.

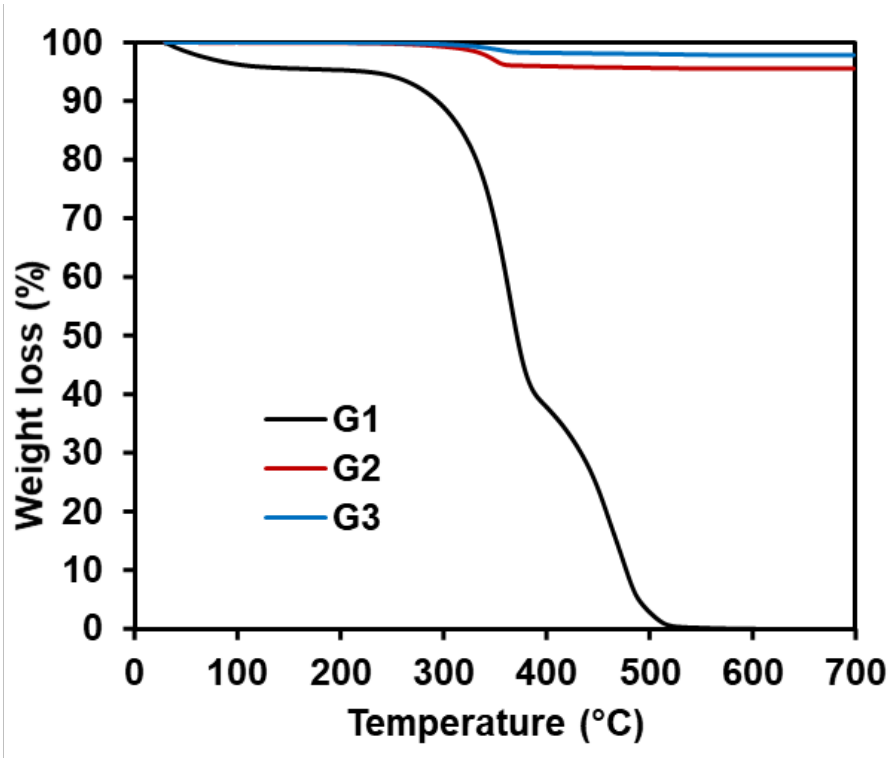

Fig. S4. TGA analysis of membranes G1 – G3.

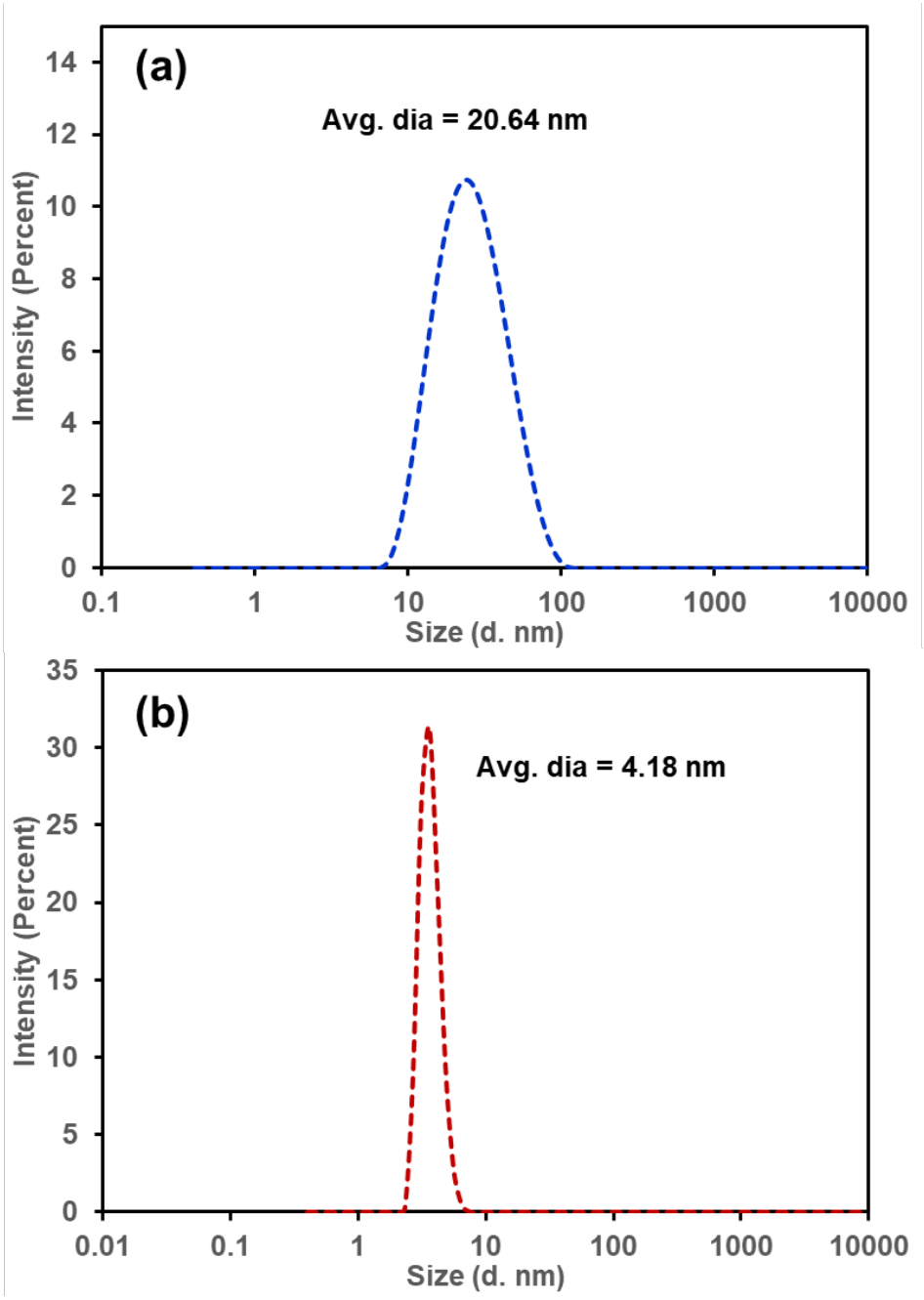

Fig. S5. Size distribution of AuNPs obtained using DLS containing the average diameter of (a) ~20.6 nm and, (b) ~4.2 nm.

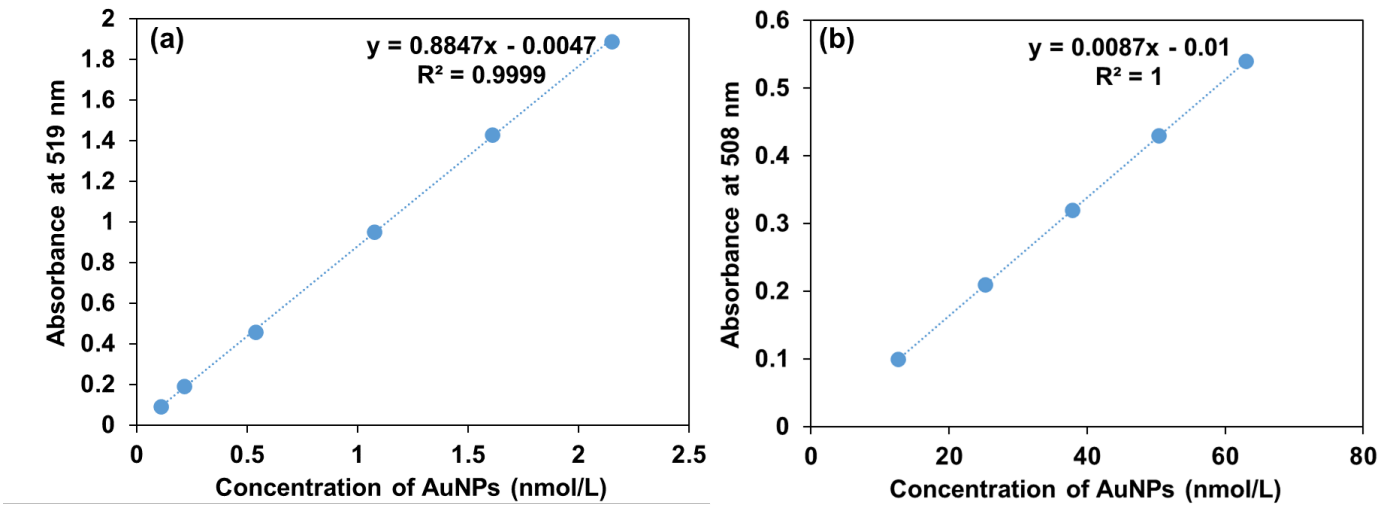

Fig. S6. Calibration curves for AuNPs of (a) 20 nm and (b) 4 nm.

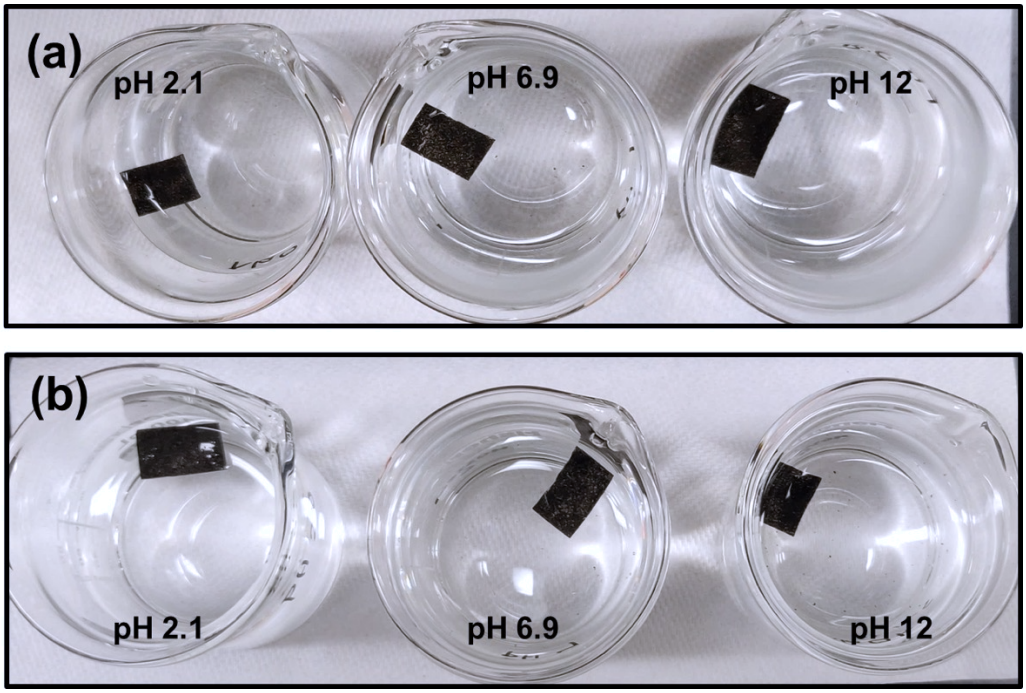

Fig. S7. G1 membranes immersed at different pH solutions (a) before and (b) after ultrasonication for 2 h.

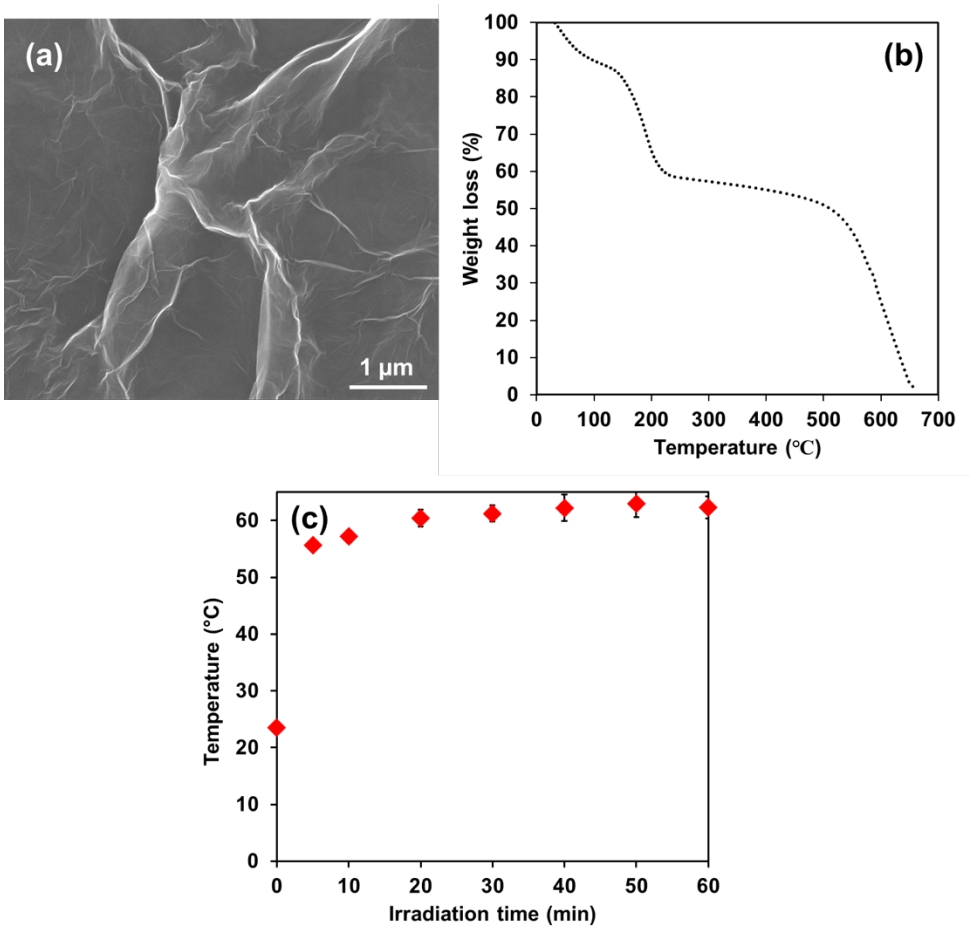

Fig. S8. SEM, TGA and photothermal properties of GO

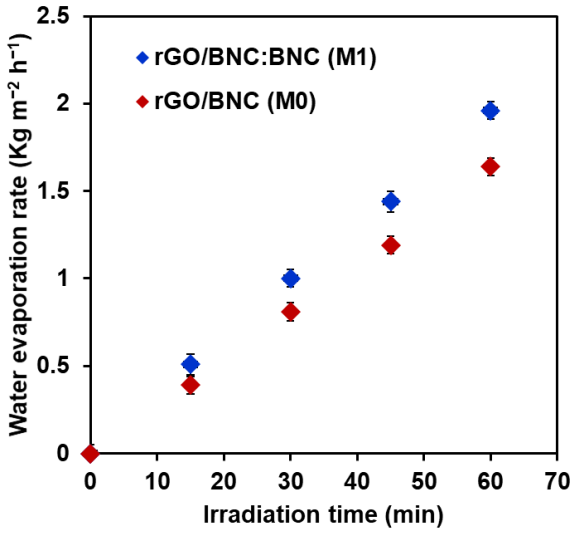

Fig. S9. Steam generation rate at the periodic interval of 15 min

Table S1: Summary of the ultrafiltration performance of different GO/rGO supported polymeric membranes in removing bacteria

Membrane	Optimum loading of GO	Applied pressure (psi)	Water flux (L h^{-1} m^{-2})	Rejection (%) (E.coli)	Inactivation (%)	Reference
rGO/Polyacrylonitrile	0.22 wt%	29	121	-	Zone of inhibition of E.coli 0.12 mm)	1
Hyperbranched polyethylenimine (HPEI) functionalized GO/polyethersulfone	3 wt%	14.5	165	-	74.88% (Initial conc. of E.coli 10^6 CFU/mL)	2
GO/polyethersulfone (electrochemical mechanism)	0.25 mg cm^{-2} of GO	14.5	100	99.99	95% (Initial conc. 10^6 CFU/mL of mixed bacterial culture) for 2V	3
Guanidyl-functionalized graphene/polysulfone	0.5 wt%	29	217	-	-	4
Ag-GO/ polyvinylidene fluoride (PVDF)	0.3 wt%	3	348.8	99.97%	94.7% (Initial conc. Of Bacillus subtilis 6.2×10^6 CFU/mL)	5
Ag/rGO/ polyethersulfone	0.2 wt%	43.5	429.8	-	-	6
Ag/GO/ polysulfone	0.5 wt%	29	87	-	-	7
rGO/Bacterial nanocellulose (Photothermal effect)	0.05 w/v% of GO in bacterial growth medium	30	149	100%	100% (Initial conc. of E.coli ~2.0 $\times$ 10^7 CFU/mL)	Present study

Table S2: Summary of solar steam generation in different GO/rGO based polymeric support membranes/foams

Photothermal material	**Supporting membrane/foam material**	**Solar illumination (kW m^{-2})**	**Maximum temperature (°C)**	**Evaporation rate**	**Reference**
rGO	Polyurethane foam	1.0	47.0	1.37	8
GO/Carbon nanotubes	silica Janus nanofibrous membrane	1.0	40.6	1.3	9
Activated carbon/GO/Multiwalled carbon nanotubes	PVDF membrane attached on the polystyrene foam embraced by cellulose sponge	1.0	45	1.55	10
Ag/rGO	melamine sponge skeleton	1.0	44.9	1.21	11
GO	halloysite nanotubes	1.0	39.1	1.62	12
rGO	Bacterial nanocellulose foam	0.6	56.9	1.95	Present study

Reference

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