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Electronic Supplementary Information (ESI)

Fullerene regulating graphene oxide nanosheet membranes with well-defined laminar nano-channels for precise molecule sieving

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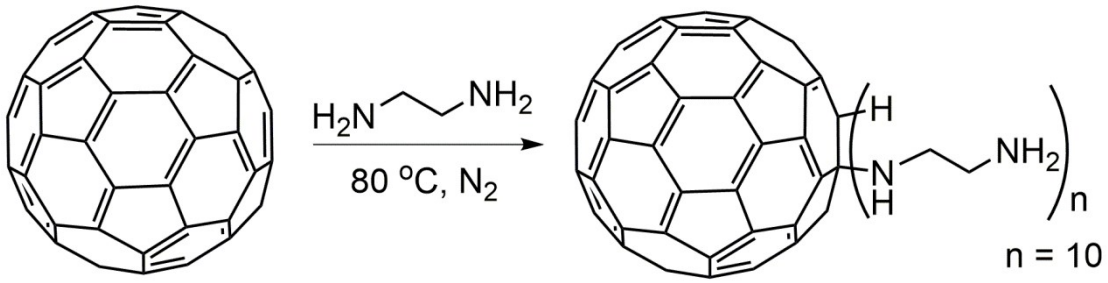

Fig. S1 Schematic for the synthesis of $C_{60}(EDA)_{10}$.

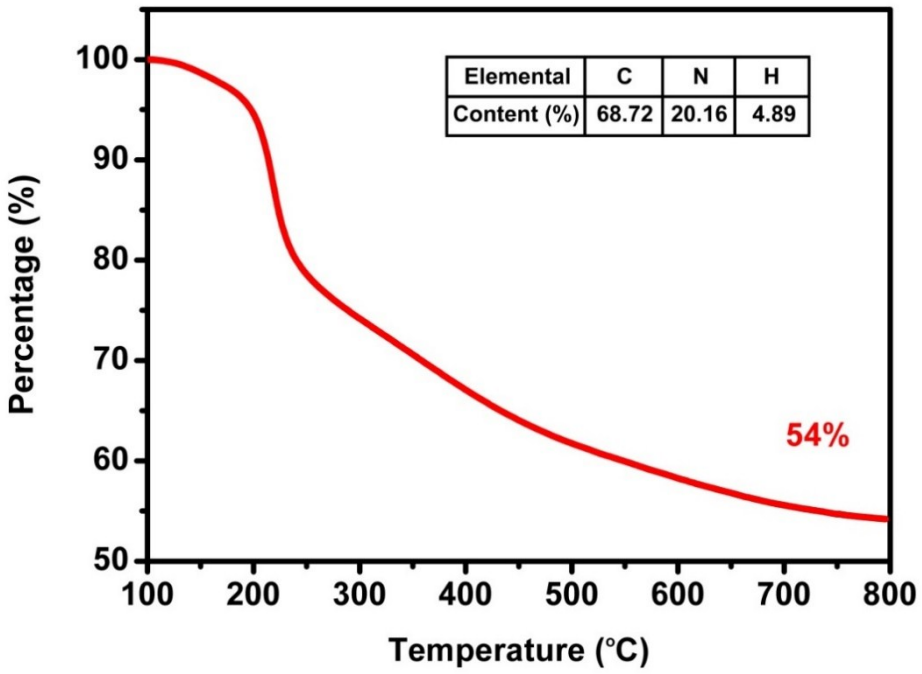

Fig. S2 TGA curve and elemental analysis of $C_{60}(EDA)_{10}$. Decomposition of $C_{60}(EDA)_{10}$ was carried out in a nitrogen gas flow (100 sccm) with a SDT Q600 TGA instrument.

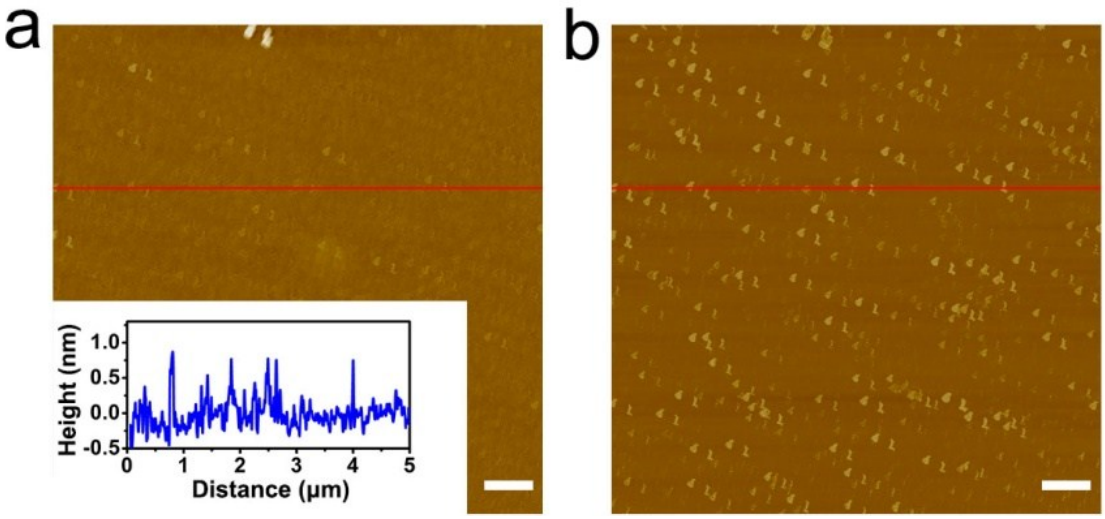

Fig. S3 Representative AFM (a) morphology image and (b) corresponding phase image of $C_{60}(EDA)_{10}$. The scale bars are 500 nm.

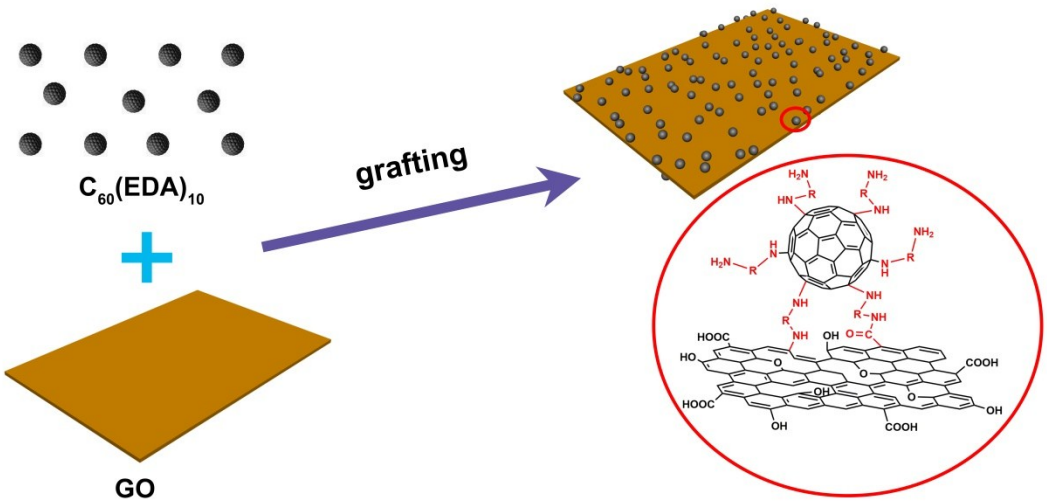

Fig. S4 Schematic for the formation of C_{60}-GONs.

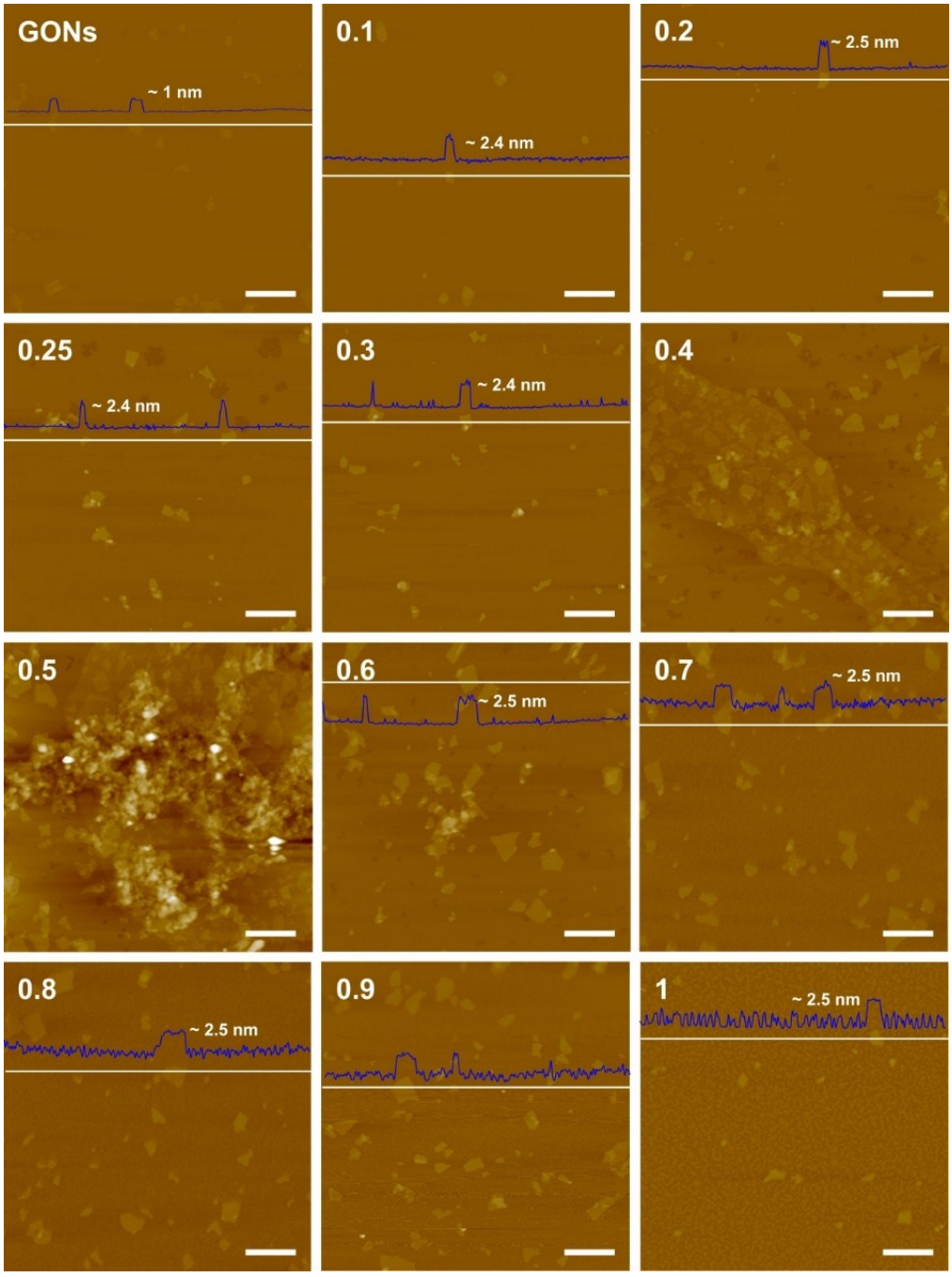

Fig. S5 AFM images of GONs and C_{60}-GONs with different $C_{60}(EDA)_{10}$/GON mass ratios. The blue plots are the height profile of GONs and C_{60}-GONs. All of the scale bars are 500 nm. Obviously, the baseline of the height profile of GONs and C_{60}-GONs with $C_{60}(EDA)_{10}$/GON mass ratios below 0.3 are flat, while are fluctuant when the mass ratios over 0.7. The fluctuation is attributed to the deposition of dissociative $C_{60}(EDA)_{10}$. This reveals that the dissociative $C_{60}(EDA)_{10}$ exist in C_{60}-GON dispersion when $C_{60}(EDA)_{10}$/GON mass ratios is over 0.7.

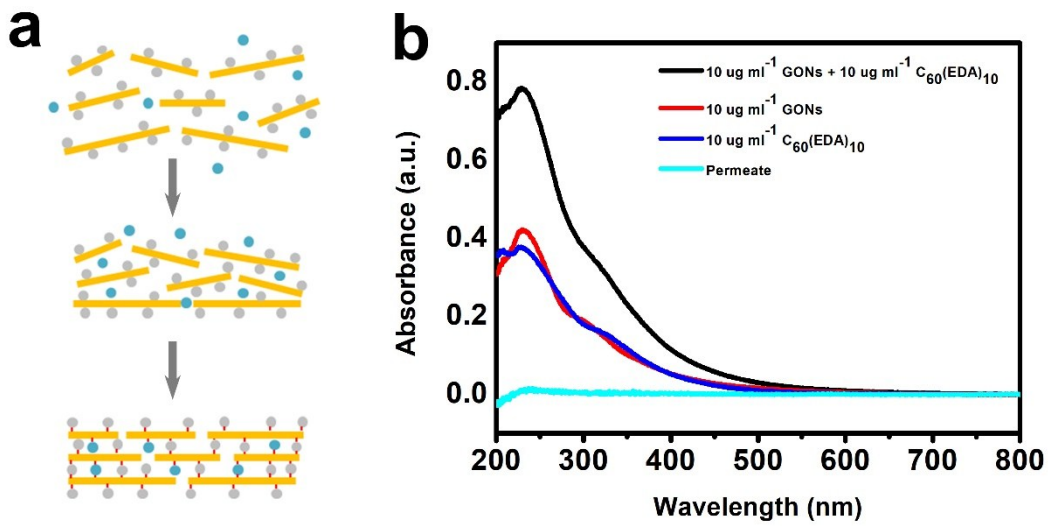

Fig. S6 Formation mechanism of the membranes with $C_{60}(EDA)_{10}$/GON mass ratio of more than 0.7. (a) Formation schematic. (b) UV-vis spectra of the permeated solution in the preparation of the membrane with the $C_{60}(EDA)_{10}$/GON mass ratio of 1.0, 10 μg ml^{-1} $C_{60}(EDA)_{10}$ and GON dispersion respectively, and the mixture of 10 μg ml^{-1} $C_{60}(EDA)_{10}$ and 10 μg ml^{-1} GONs.

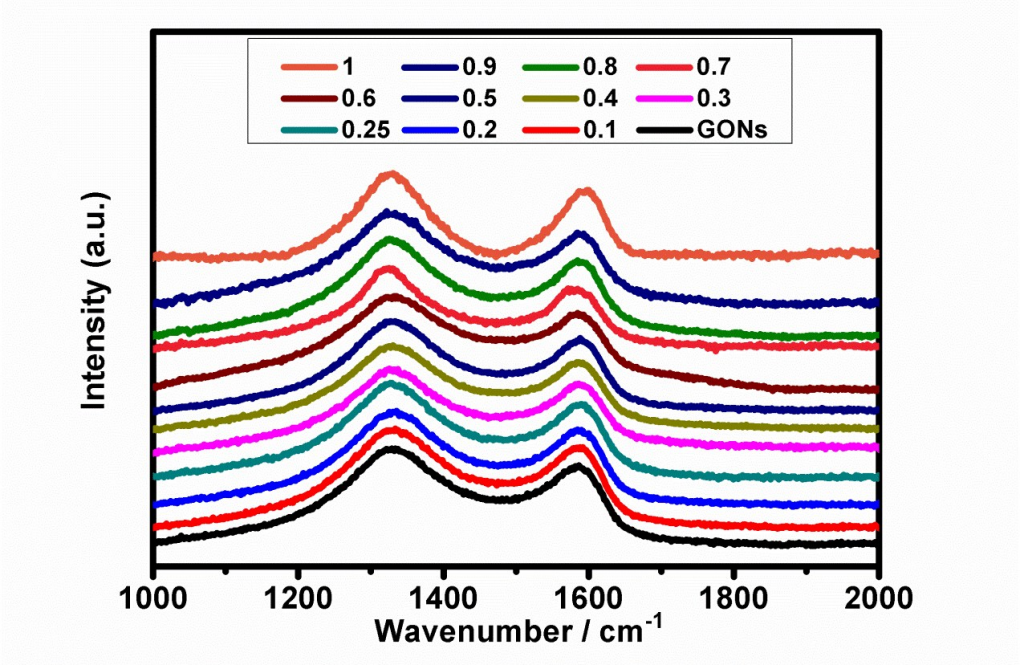

Fig. S7 Raman spectra of C_{60}-GON membranes with different $C_{60}(EDA)_{10}$/GON mass ratios.

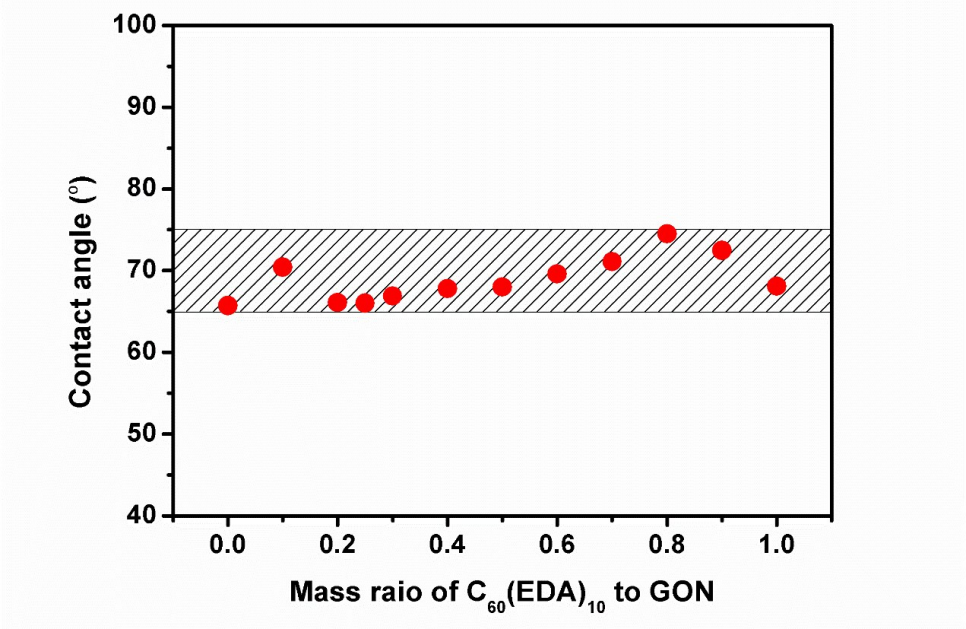

Fig. S8 Static water contact angles of C_{60}-GON membranes with different $C_{60}(EDA)_{10}$/GON mass ratios.

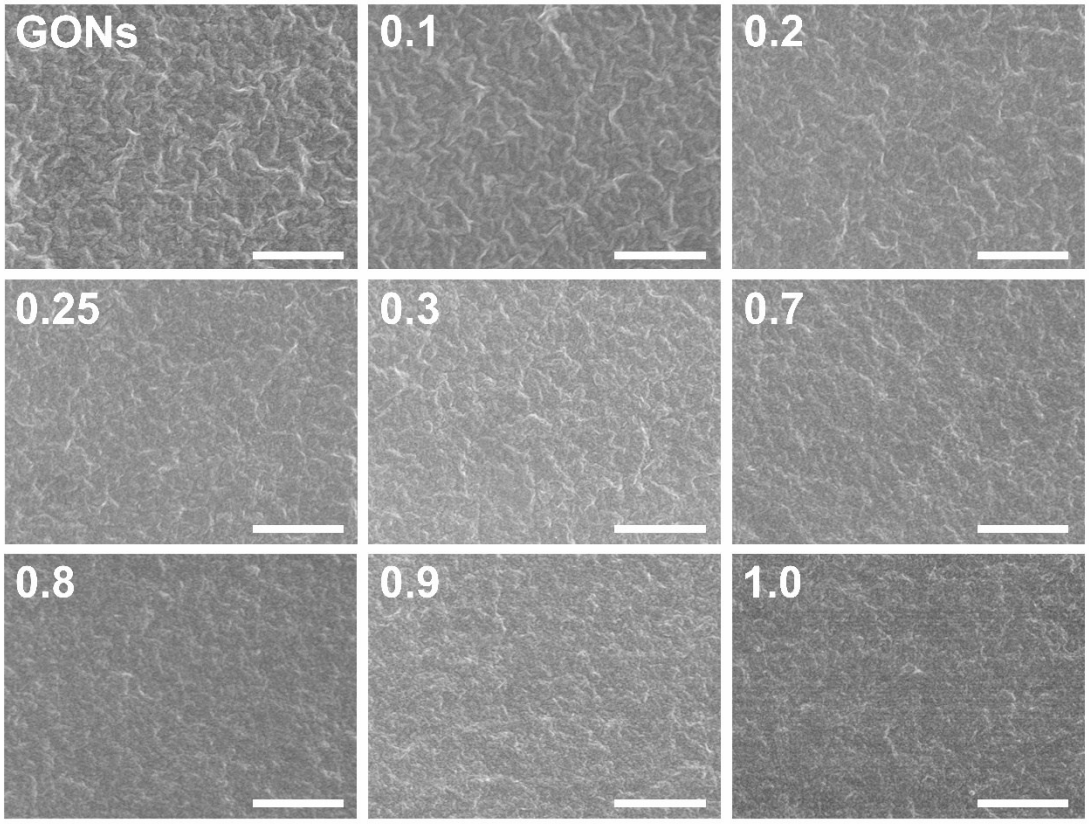

Fig. S9 Surface SEM images of C_{60}-GON membranes with different $C_{60}(EDA)_{10}$/GON mass ratios. The scale bars are 2 μm.

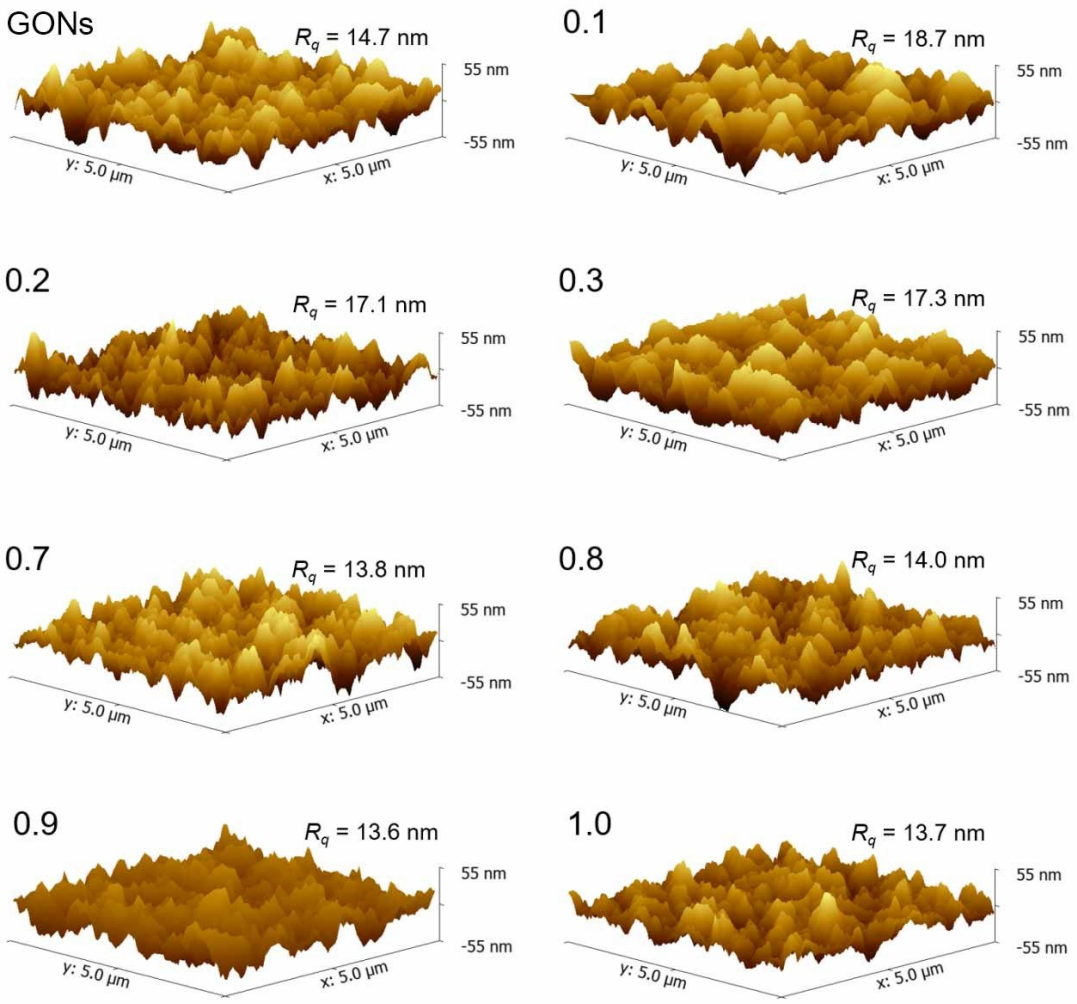

Fig. S10 3D AFM images of C_{60}-GON membranes with different $C_{60}(EDA)_{10}$/GON mass ratios.

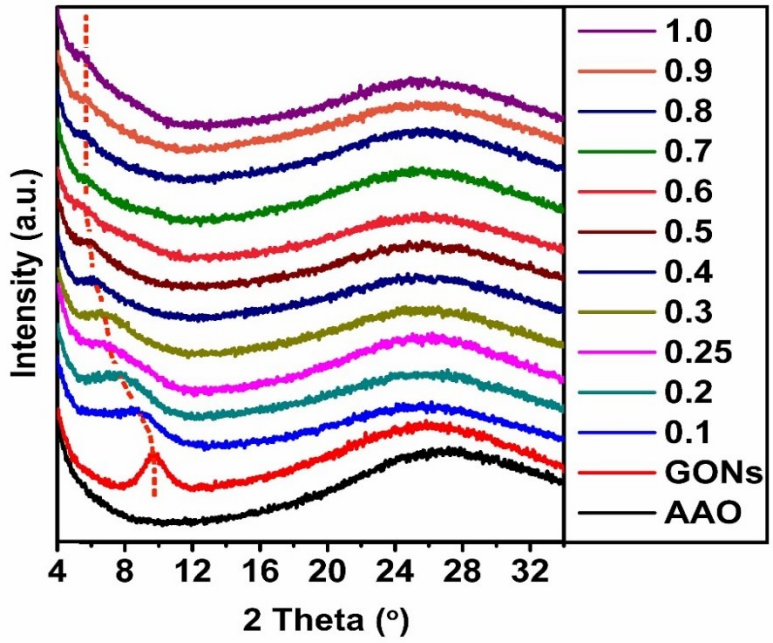

Fig. S11 PXRD spectra of C_{60}-GON membranes with different $C_{60}(EDA)_{10}$/GON mass ratios.

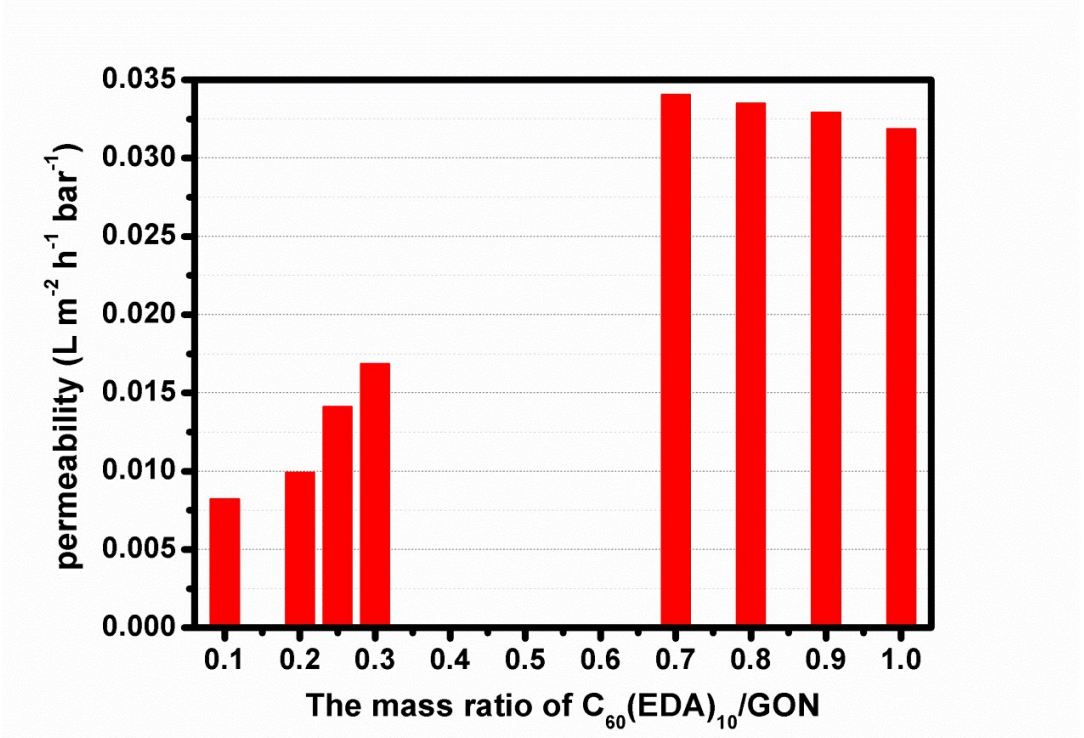

Fig. S12 Theoretical water permeability of C_{60}-GON membranes with different $C_{60}(EDA)_{10}$/GON mass ratios.

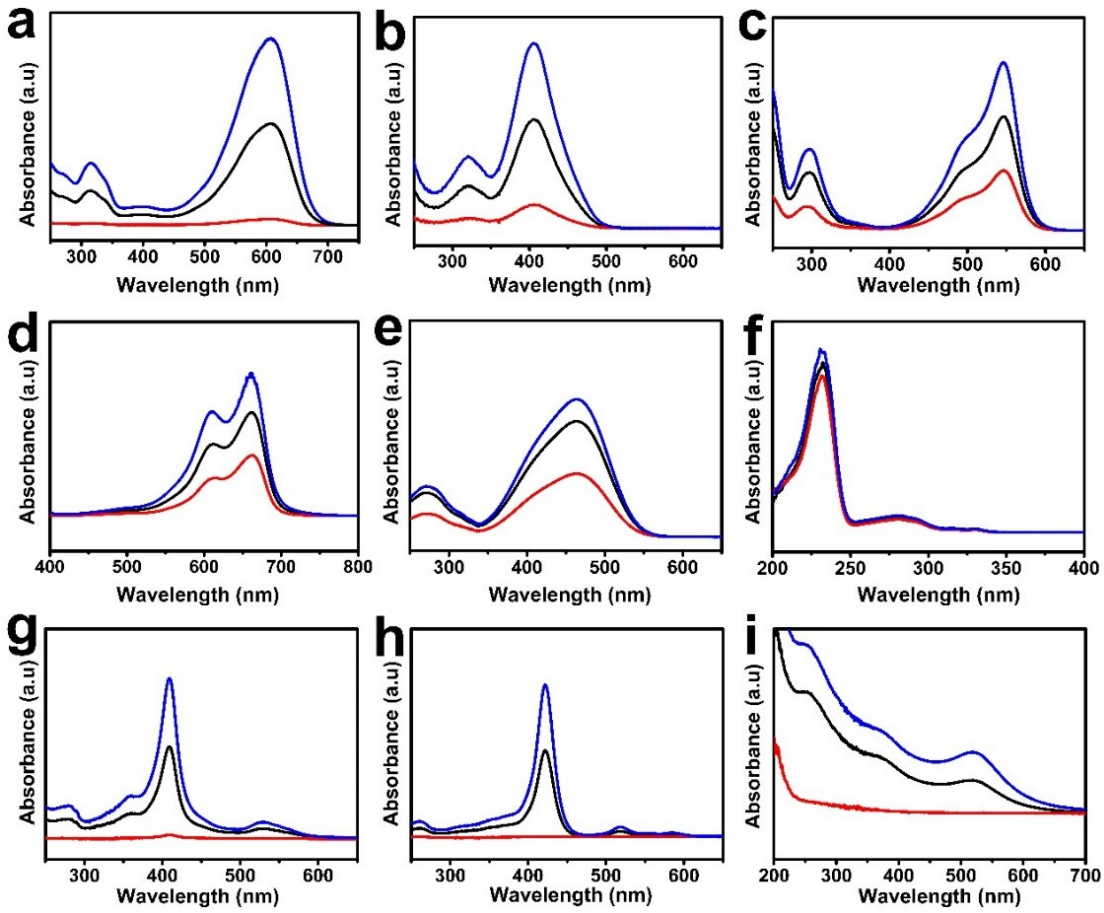

Fig. S13 UV-vis spectra in the separation of dye solutions by using the membrane with the $C_{60}(EDA)_{10}$/GON mass ratio of 0.7. The blue line, black line and red line corresponds to the concentrated, the feed and the permeate solution. (a) EB; (b) TY; (c) AF; (d) MB; (e) MO; (f) HNSA; (g) Cyt.C; (h) TMPyP; (i) Au colloid.

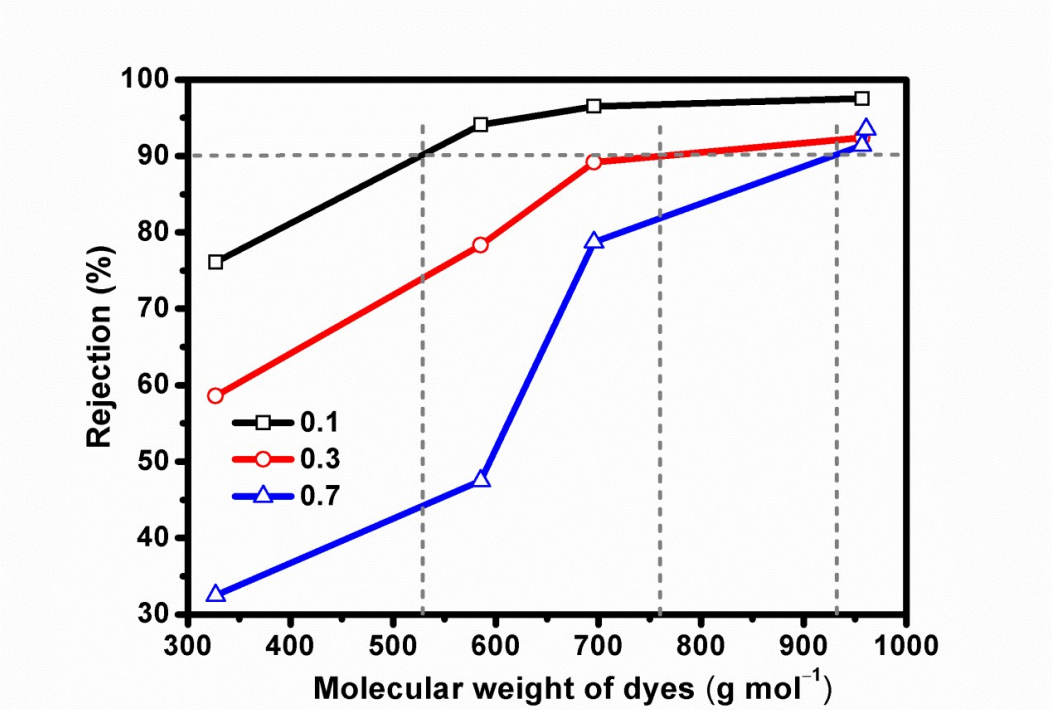

Fig. S14 The molecular weight cut-off (MWCO) of C_{60}-GON membranes. Here the MWCO refers to molecular weight of solute that is retained 90% by the membrane.

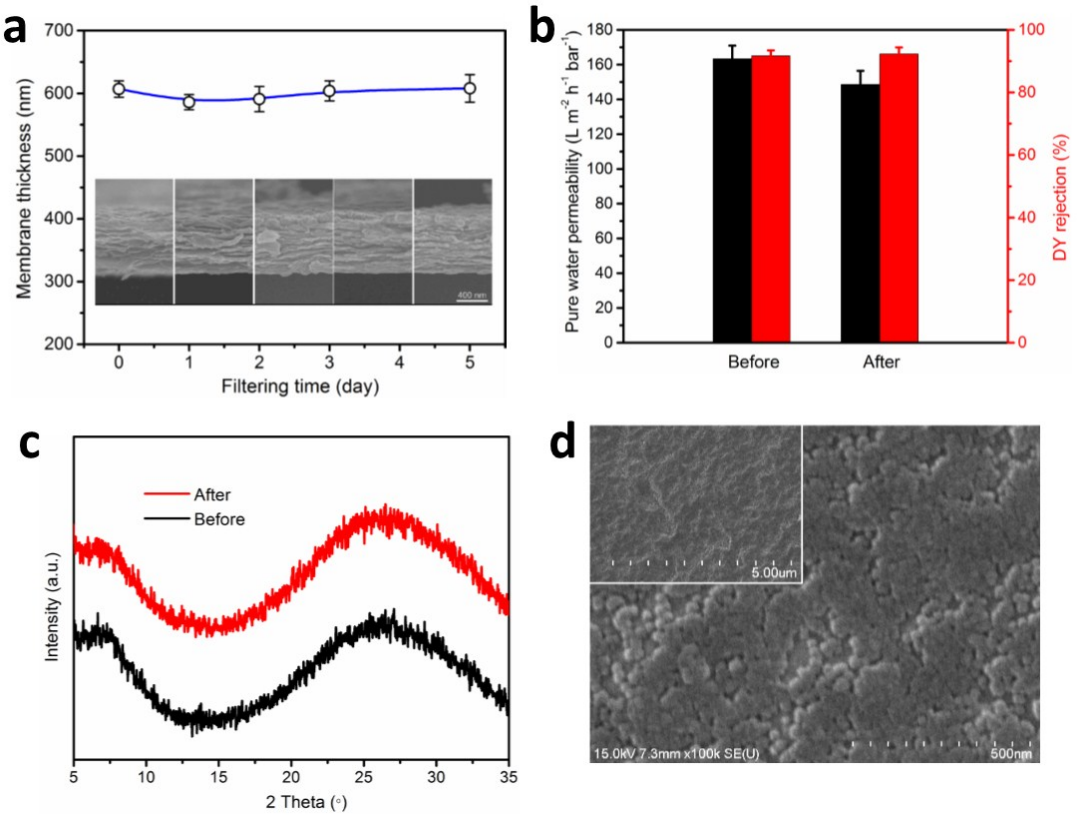

Fig. S15 (a) The change of the thickness of membrane with $C_{60}(EDA)_{10}$/GON mass ratio of 0.7 in the filtration of pure water. (b) The water permeability and DY rejection of the membrane with the $C_{60}(EDA)_{10}$/GON mass ratio of 0.7 before and after the separation test of mixed dyes. (c) The XRD patterns of the membrane with the $C_{60}(EDA)_{10}$/GON mass ratio of 0.7 before and after the test of mixed dyes. (d) SEM images of the membrane with the $C_{60}(EDA)_{10}$/GON mass ratio of 0.7 after the test of mixed dyes.

Table S1. Molecule rejections of the C_{60}-GON membrane with the $C_{60}(EDA)_{10}$/GON mass ratio of 0.7 at 20 ˚C.

Molecules[a)]	MW (g mol^{-1})	Concentration	Size	Charge	Rejection (%)
EB	960.8	10 μg ml^{-1}	1.2×3.1 nm^2	–	93.5±1.8
DY	956.8	10 μg ml^{-1}	1.7×2.7 nm^2	–	91.4±1.1
TY	695.7	5 μg ml^{-1}	0.97×2.5 nm^2	–	78.4±1.4
AF	585.5	5 μg ml^{-1}	1.18 nm^3	–	47.5±1.7
MB	319.1	5 μg ml^{-1}	0.854×1.58 nm^2	+	41.3±1.2
MO	327.3	5 μg ml^{-1}	0.86 nm^3	–	32.5±2.0
HNSA	246.2	10 μg ml^{-1}	0.59 nm^3	–	11.7±2.7
Cyt.C	12 kD	10 μg ml^{-1}	2.5×2.5×3.7 nm^3	+	95.9±1.7
TMPyP	1363.6	1.5 μM	1.7×1.7 nm^2	+	99±0.7
Au colloid	/	4.5×10^9 unit ml^{-1}	5 nm in diameter	–	100±0

[a] EB, evans blue; DY, direct yellow 50; TY, titan yellow; AF, acid fuchsin; MB, methylene blue; MO, methyl orange; HNSA, sodium 6-hydroxynaphthalene-2-sulfonate; Cyt.C, cytochrome C; TMPyP, 5,10,15,20-tetrakis-(N-methyl-4-pyridyl)-21,23-H-porphyrin tetratosylate.