**Supporting Information Section for *Journal of Materials Chemistry A***

# Facile Fabrication of Freestanding All-carbon Activated Carbon Membranes for High-performance and Universal Pollutant Management

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# The contribution of KY and XZ is equal.

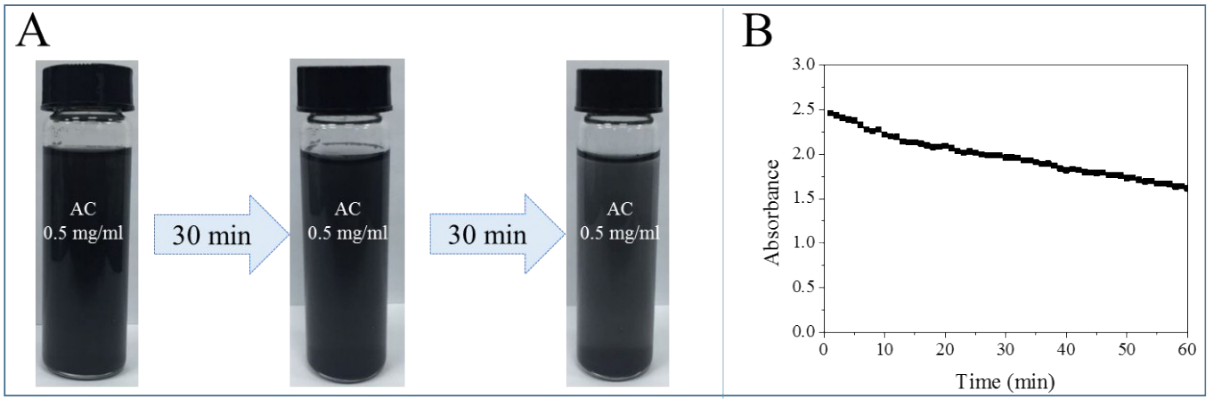


**Figure S1.** The direct observation of particle AC dispersed in water (pH=11, after 10 min ultrasonication) (A) and the UV detection of AC precipitation as the function of quiescent time (λ=600 nm) (B).

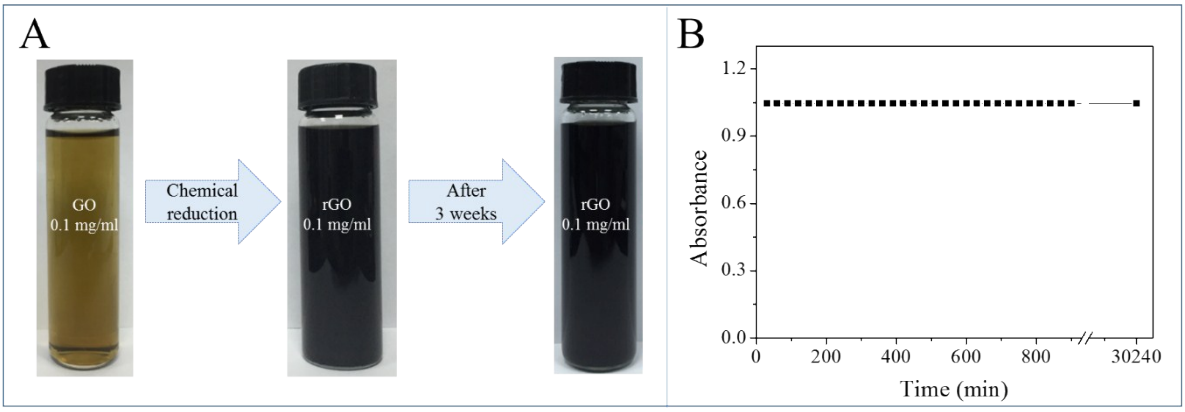


**Figure S2.** The color change of GO after reduction and the optical observation of rGO's stable dispersion (A) and the UV detection of rGO dispersion in water ($C_{rGO}$=0.02 mg/ml, λ=240 nm) (B).

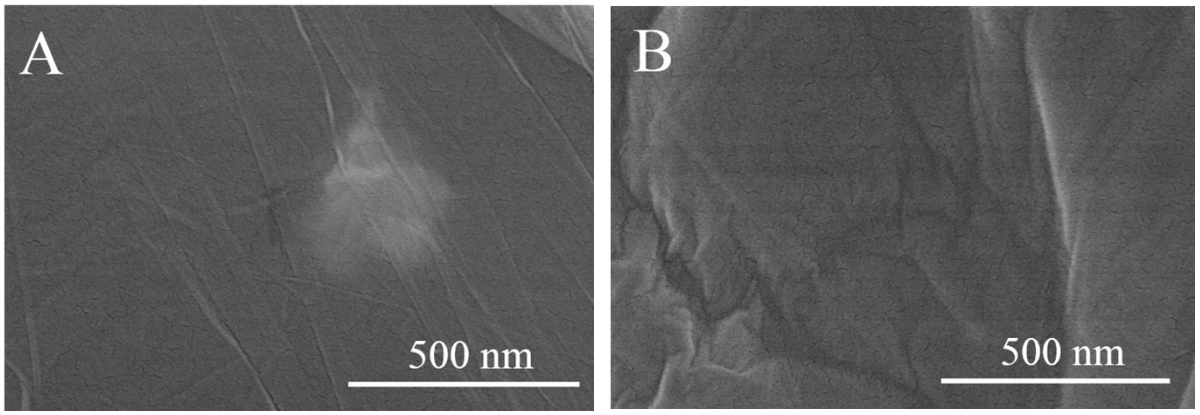


**Figure S3.** The interaction between AC and rGO under high magnification.

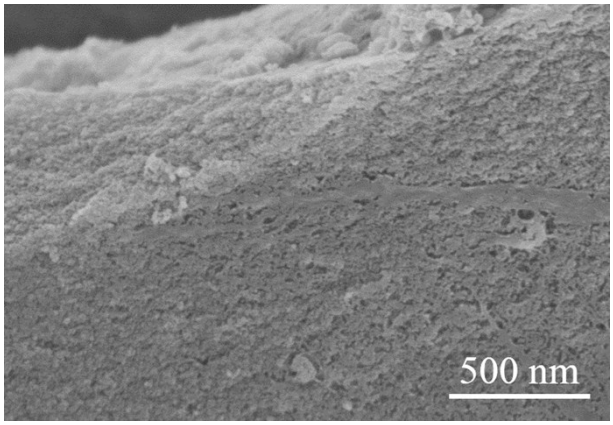


**Figure S4.** The porous structure of pristine AC under SEM.

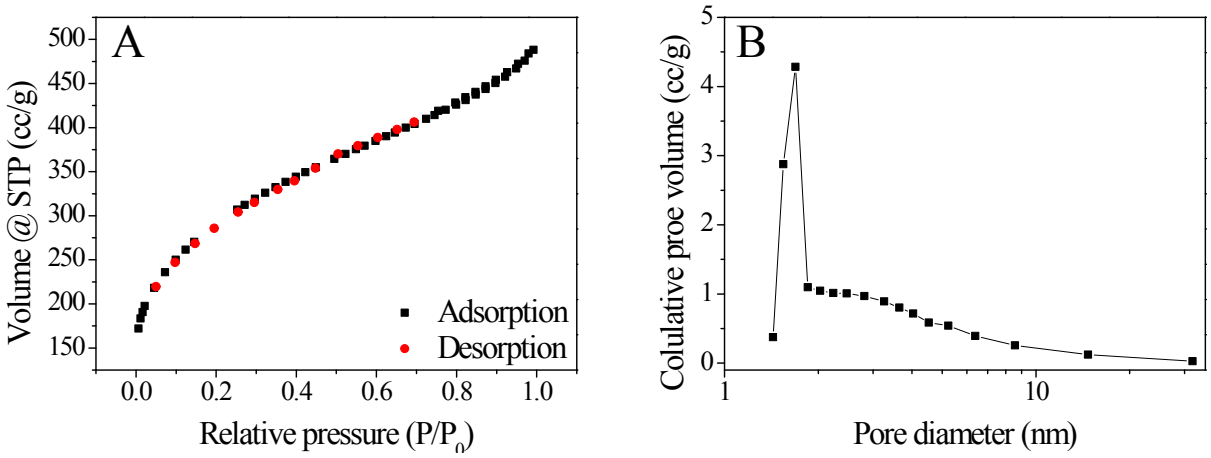


**Figure S5.** The $N_2$ adsorption-desorption under different pressure (A) and pore size distribution (B) of AC.

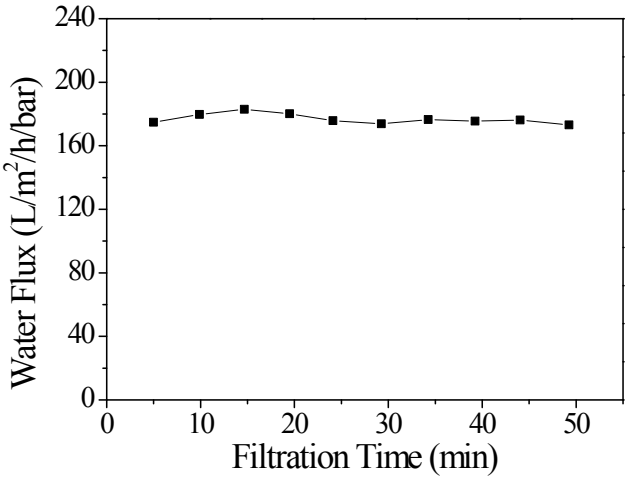


**Figure S6.** The water flux variation of ACM_5-4 as a function of operation time.

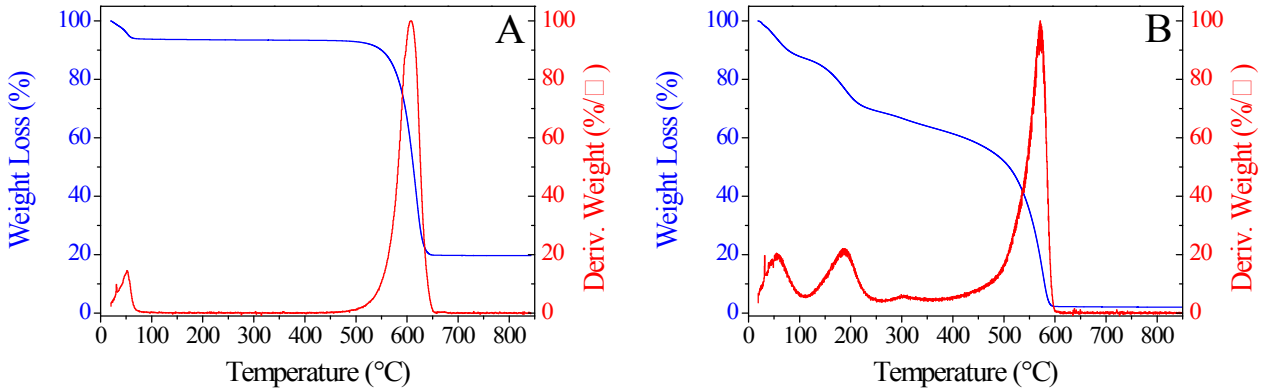


**Figure S7.** The thermal gravimetric analysis (TG) and differential thermal gravimetric analysis (DTG) of AC (A) and rGO (B).

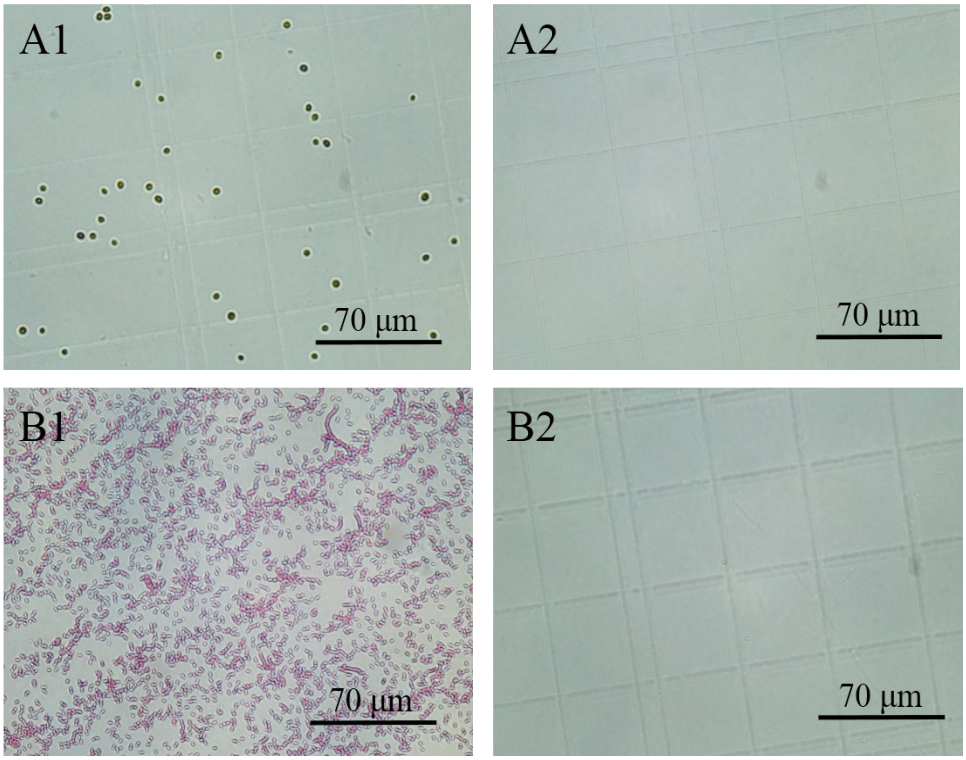


**Figure S8.** The microscope count of chlorella number in dispersion before filtration (A1), after filtration (A2) and E. coli number in dispersion before filtration (B1), after filtration (B2) on counting plate under microscope observation.

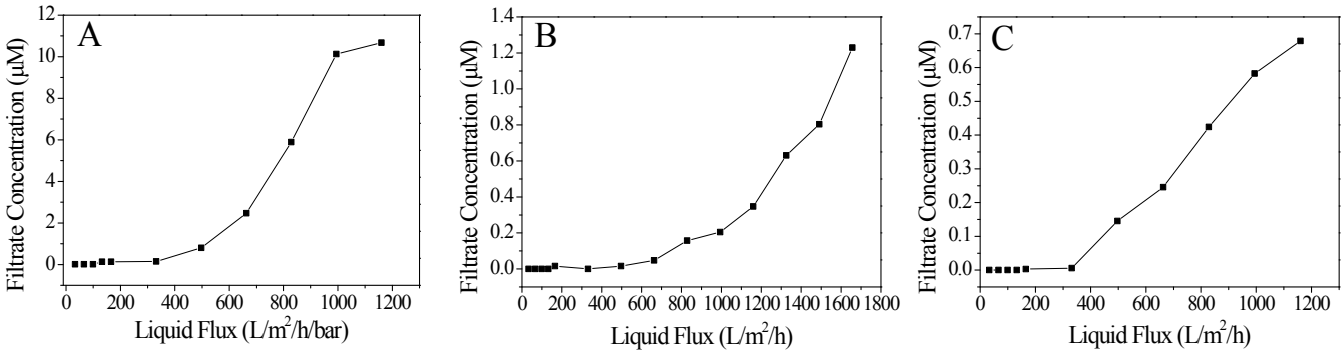


**Figure S9.** The adsorption kinetic of ACM_20-1 to silver ions (A) methylene blue (B) and phenanthrene (C).

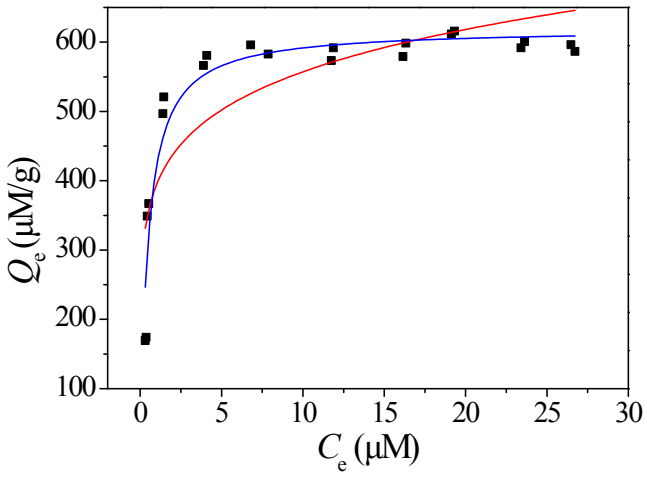


**Figure S10.** The adsorption isotherms of methylene blue onto particle activated carbon. The red line present the isotherm fitted by Freundlich model and the blue line present the isotherm fitted by Langmuir model.

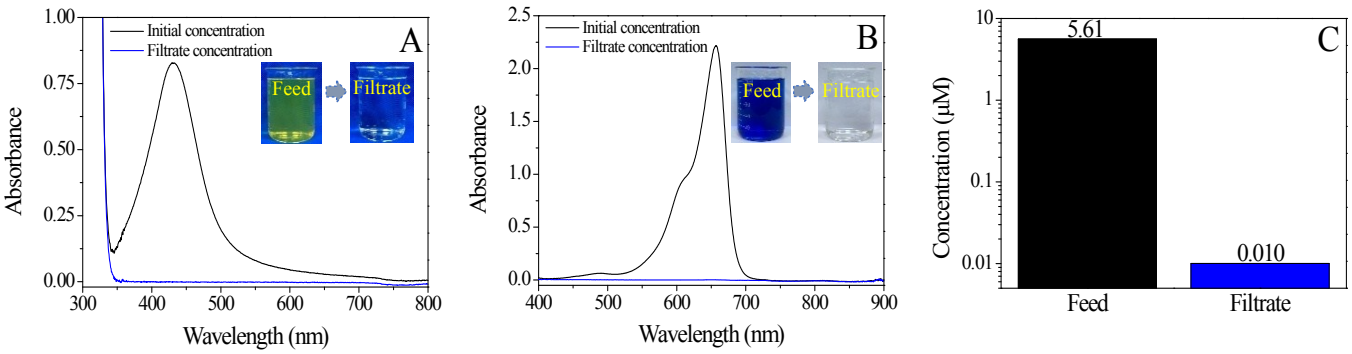


**Figure S11.** The sieving performance of ACM_5-7 to silver nanoparticles in acetone (A) and the adsorption performance of ACM_5-7 to methylene blue (B) and phenanthrene (C).

**Table S1.** The physic-chemical parameters of water and each solvent.

| Samples | Molecular weight (g/mol) | Density @ 25 ℃ (g/ml) | Viscosity @ 25 ℃ (cP) | Boiling point (℃) |
|---|---|---|---|---|
| Water | 18.02 | 1 | 0.8937 | 100 |
| Acetone | 58.08 | 0.786 | 2.885 | 56 |
| N-hexane | 86.18 | 0.656 | 0.296 | 69 |
| Ethanol | 46.07 | 0.787 | 1.057 | 78 |
| Toluene | 92.14 | 0.865 | 0.548 | 110.6 |
| Chloroform | 119.38 | 1.48 | 0.539 | 61.3 |

**Table S2.** Regression parameters of adsorption isotherms of methylene blue onto particle activated carbon fitted by Freundlich and Langmuir model.

| Sample | Freundlich | | | Langmuir | | |
|---|---|---|---|---|---|---|
| | $K_f$ | N | $R^2$ | $Q_m$ | K | $R^2$ |
| Particle activated carbon | 394.29 | 0.15 | 0.705 | 619.78 | 0.476 | 0.925 |