Supporting Information

for

A facile and green method to fabricate graphene-based multifunctional hydrogel for miniature water purification

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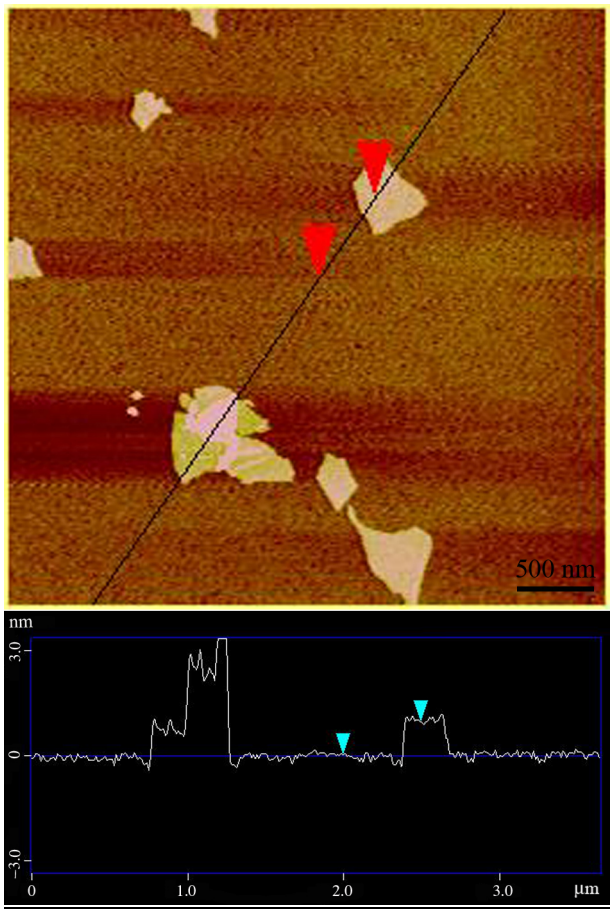

Fig. S1 AFM image of the obtained GO sheets. The result shows that the average thickness of the GO sheets is 1.0 nm.

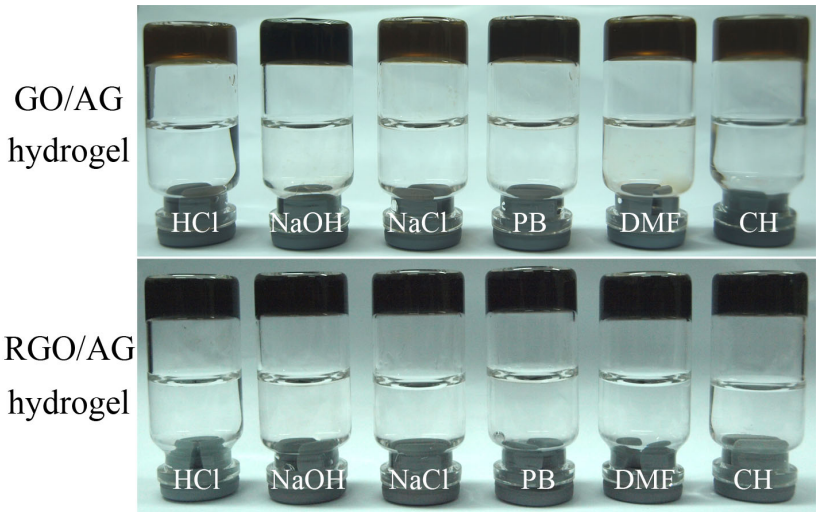

Fig. S2 Stability investigation of the GO/AG and RGO/AG hydrogel against the acid, alkali, NaCl, buffer, and organic solvent. From left to right: HCl (0.1 mol/L), NaOH (0.1 mol/L), NaCl aqueous solution (1 mol/L), PB (pH 7.4, 10 mM), DMF and CH. Each of the above solution (5 mL) was added onto the hydrogel (2 mL), and the samples were allowed to stand at room temperature for one week.

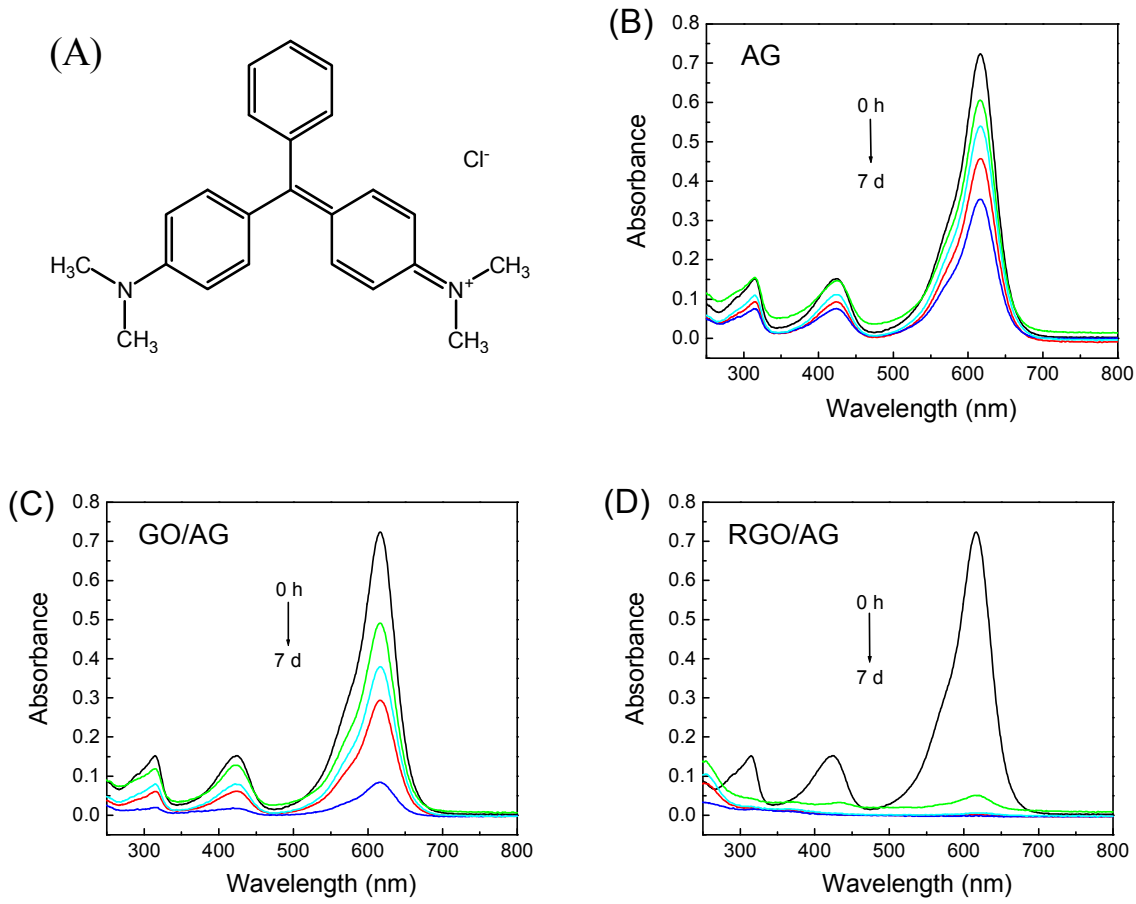

Fig. S3 UV-vis absorption spectra showing the adsorption process of malachite green (MG) by graphene/AG hydrogel in one week. (A) Molecular structure of MG. (B-D) UV-vis absorption spectra of residual MG in solution after adsorption by AG, GO/AG, and RGO/AG hydrogel at different time points (0 h, 6 h, 12 h, 24 h, 7 d), respectively.

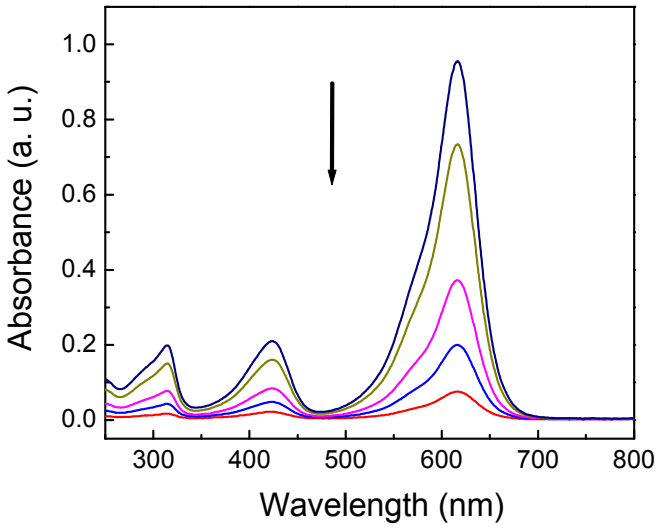

Fig. S4 UV-vis absorption spectra showing the adsorption of MG by GO/AG hydrogel containing different amount of GO (from top to bottom trace: 0, 0.25, 0.5, 0.75, and 1.0 mg/mL). The solutions used for UV-vis measurement were obtained after 7 days of adsorption by GO/AG hydrogel.

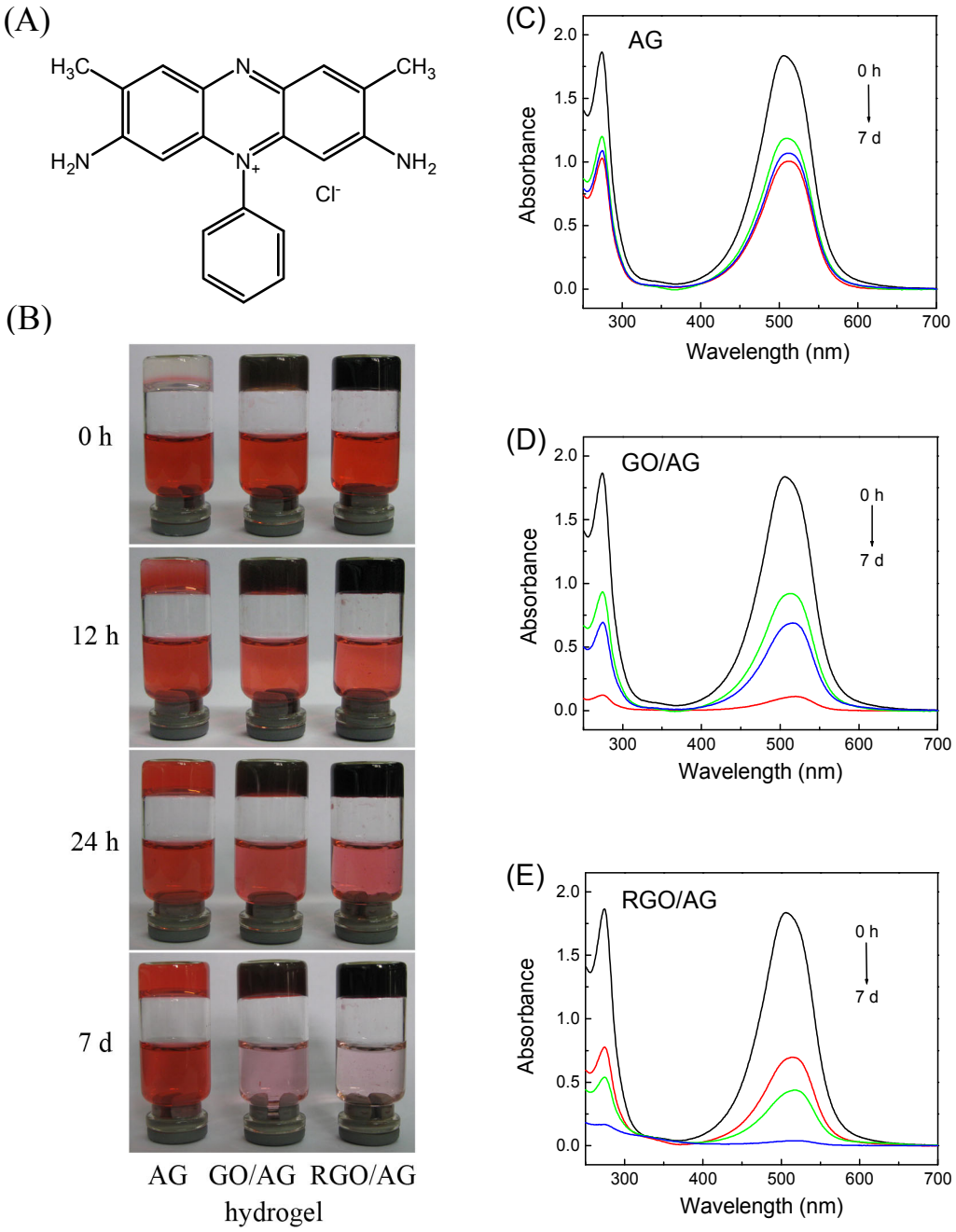

Fig. S5 Photograph and UV-vis absorption spectra showing the adsorption process of safranine T (ST) by graphene/AG hydrogel in one week. (A) Molecular structure of ST. (B) Photograph showing the adsorption process of ST by AG, GO/AG, and RGO/AG hydrogel at different time points (0 h, 12 h, 24 h, 7 d), respectively. (C-E) UV-vis absorption spectra of residual MV in the solution after adsorption by AG, GO/AG, and RGO/AG hydrogel at different time points, respectively, which are corresponding to the photograph in (B).

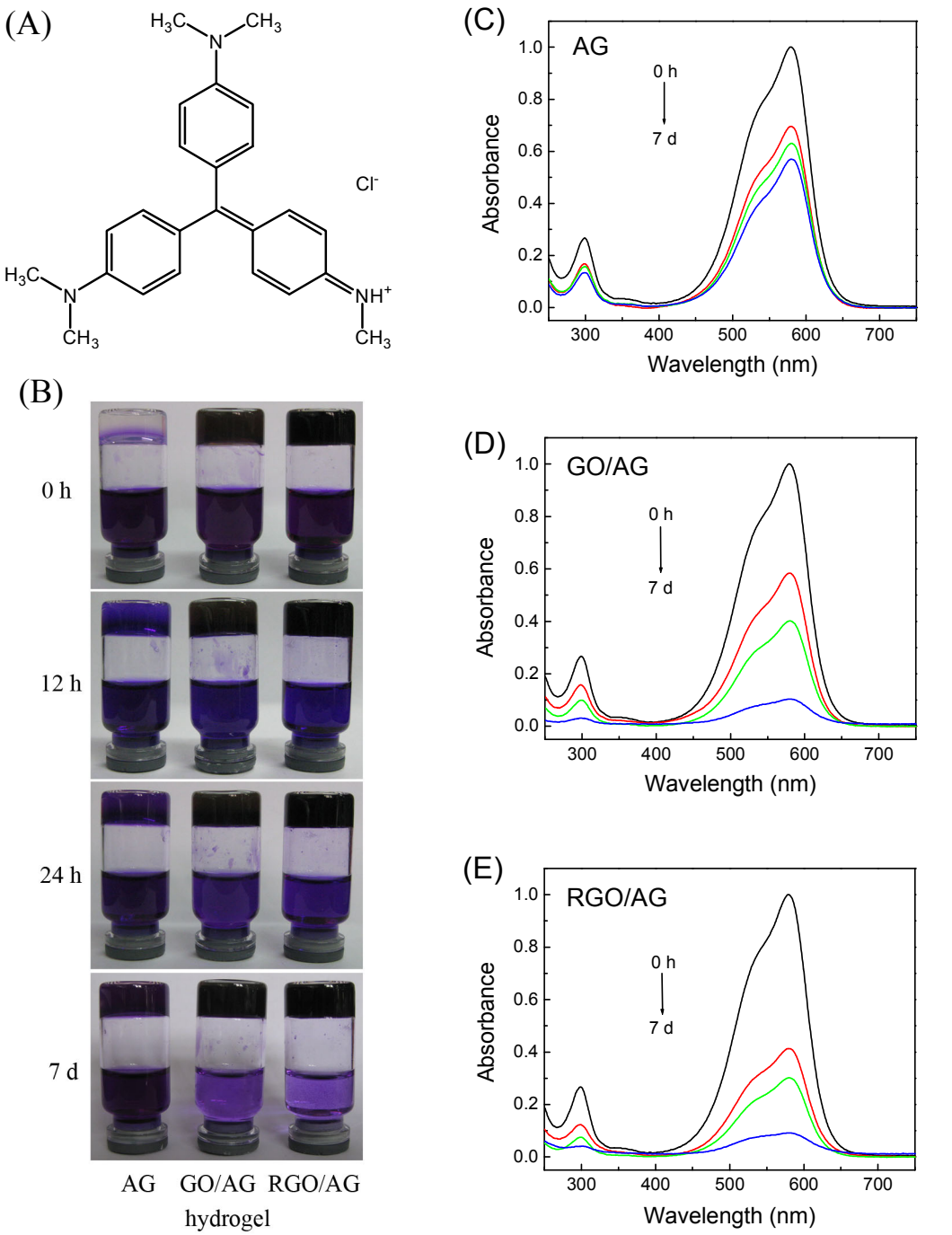

Fig. S6 Photograph and UV-vis absorption spectra showing the adsorption process of methyl violet (MV) by graphene/AG hydrogel in one week. (A) Molecular structure of MV. (B) Photograph showing the adsorption process of MV by AG, GO/AG, and RGO/AG hydrogel at different time points (0 h, 12 h, 24 h, 7 d), respectively. (C-E) UV-vis absorption spectra of residual MV in the solution after adsorption by AG, GO/AG, and RGO/AG hydrogel at different time points, respectively, which are corresponding to the photograph in (B).

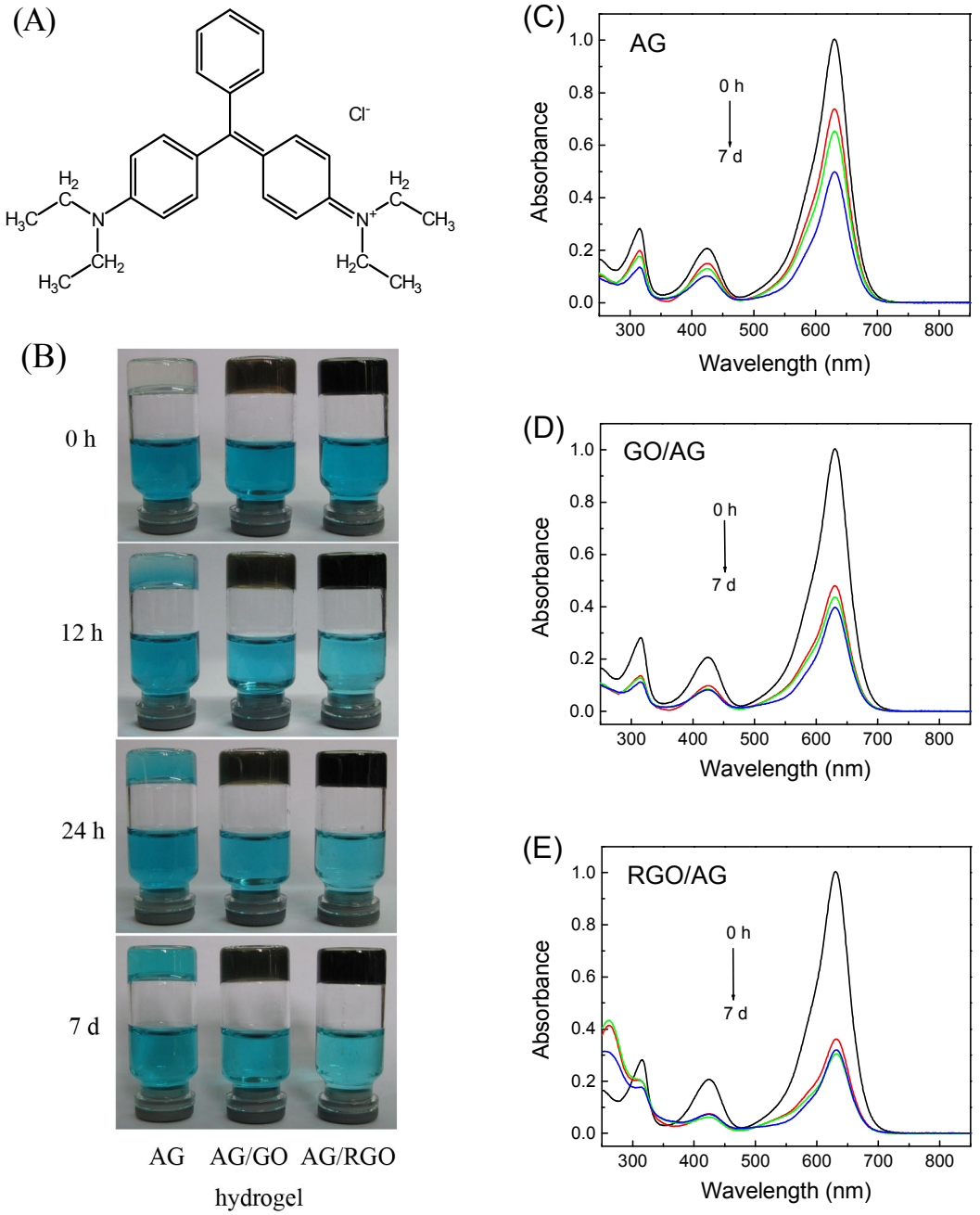

Fig. S7 Photograph and UV-vis absorption spectra showing the adsorption process of brilliant green (BG) by graphene/AG hydrogel in one week. (A) Molecular structure of BG. (B) Photograph showing the adsorption process of BG by AG, GO/AG, and RGO/AG hydrogel at different time points (0 h, 12 h, 24 h, 7 d), respectively. (C-E) UV-vis absorption spectra of residual BG in the solution after adsorption by AG, GO/AG, and RGO/AG hydrogel at different time points, respectively, which are corresponding to the photograph in (B).

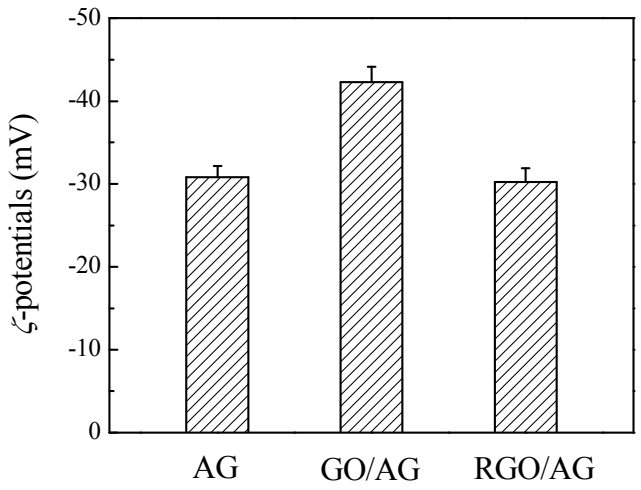

Fig. S8 ξ–potential measurements of AG, GO/AG and RGO/AG in the aqueous solution. The values of ξ–potential were -30.8 ± 1.37, -42.3 ± 1.85, and -30.2 ± 1.70 mV for AG, GO/AG and RGO/AG hydrogel, respectively.

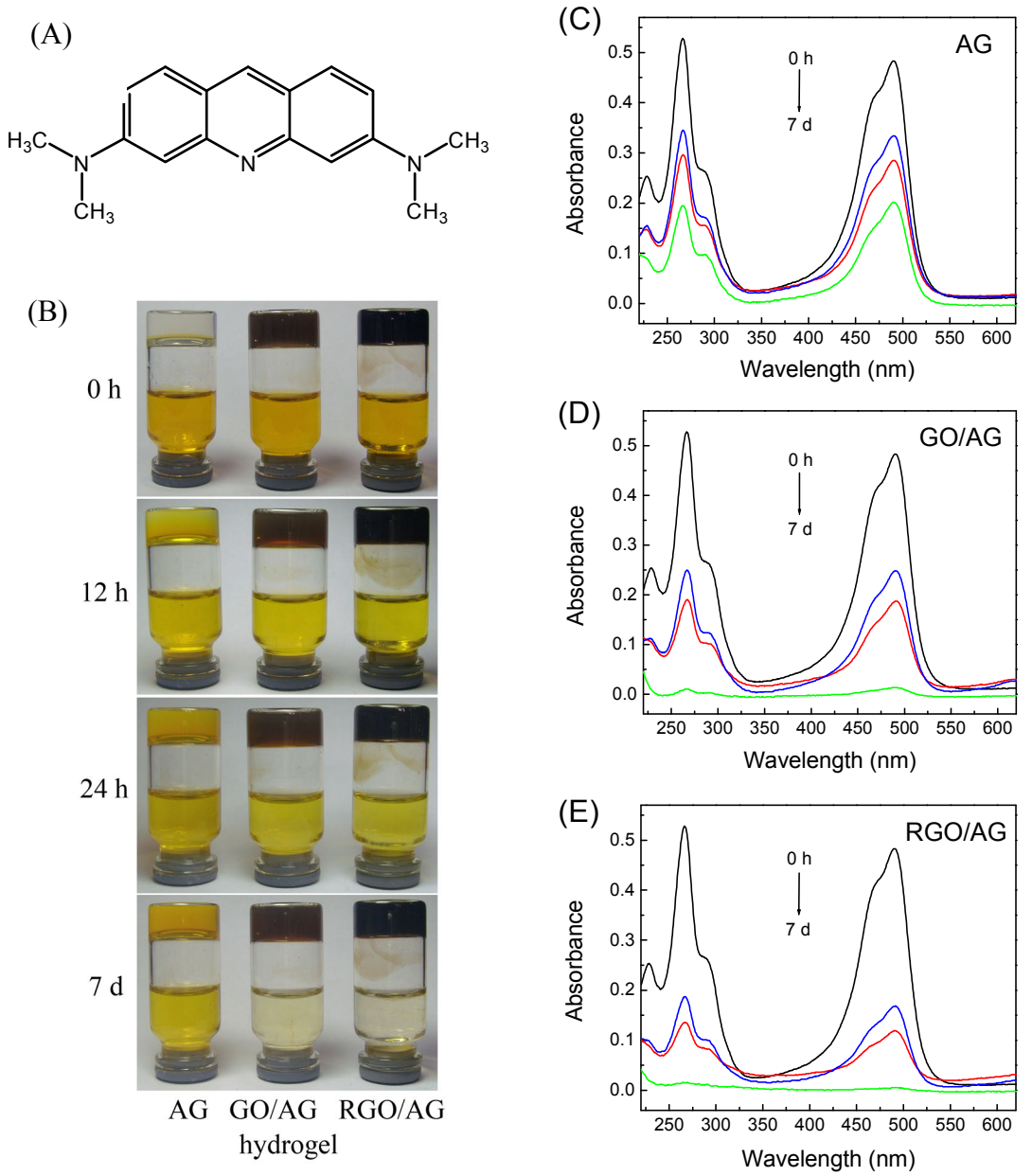

Fig. S9 Photograph and UV-vis absorption spectra showing the adsorption process of acridine orange (AO) by graphene/AG hydrogel in one week. (A) Molecular structure of AO. (B) Photograph showing the adsorption process of AO by AG, GO/AG, and RGO/AG hydrogel at different time points (0 h, 12 h, 24 h, 7 d), respectively. (C-E) UV-vis absorption spectra of residual AO in the solution after adsorption by AG, GO/AG, and RGO/AG hydrogel at different time points, respectively, which are corresponding to the photograph in (B).

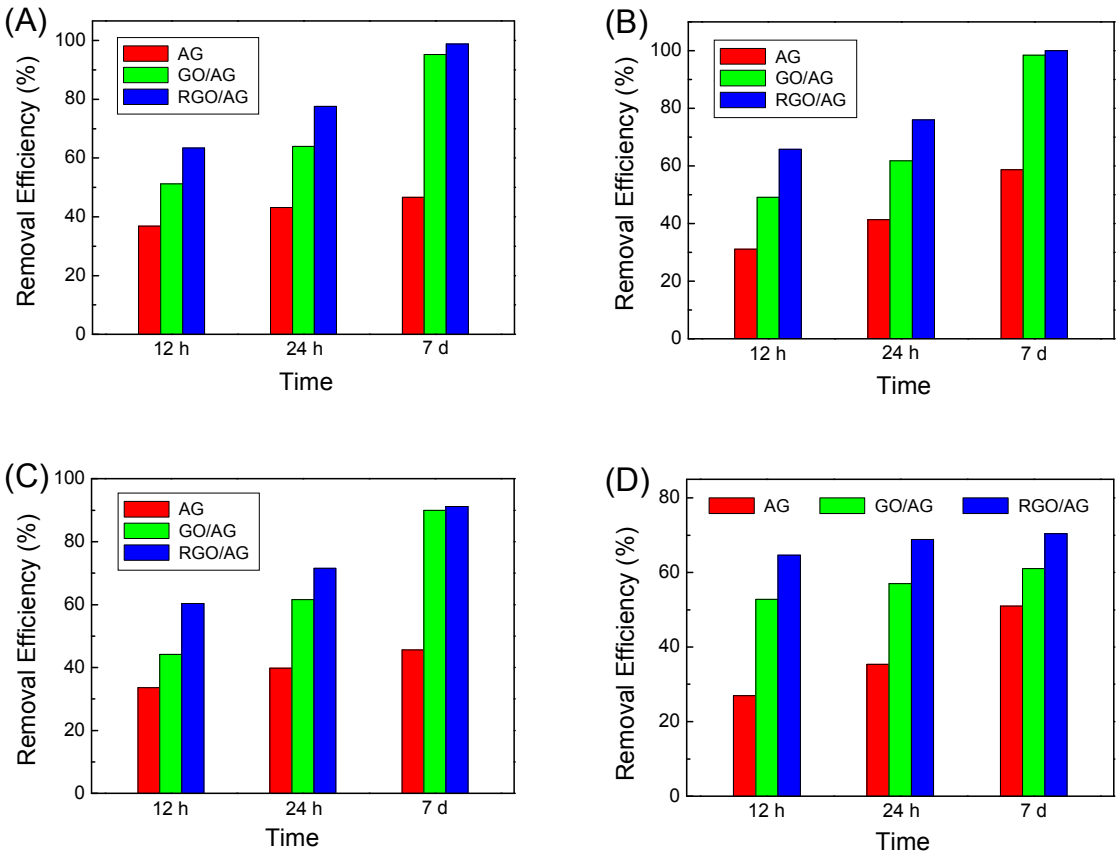

Fig. S10 The removal efficiencies of the four dyes used in the present work, which were adsorbed by AG, GO/AG, and RGO/AG hydrogels at different time points: (A) ST, (B) AO, (C) MV, and (D) BG. The efficiencies were calculated according to the maximum absorbance value of these dyes in the UV-vis spectra and the standard working plots shown in Fig. S12-S16.

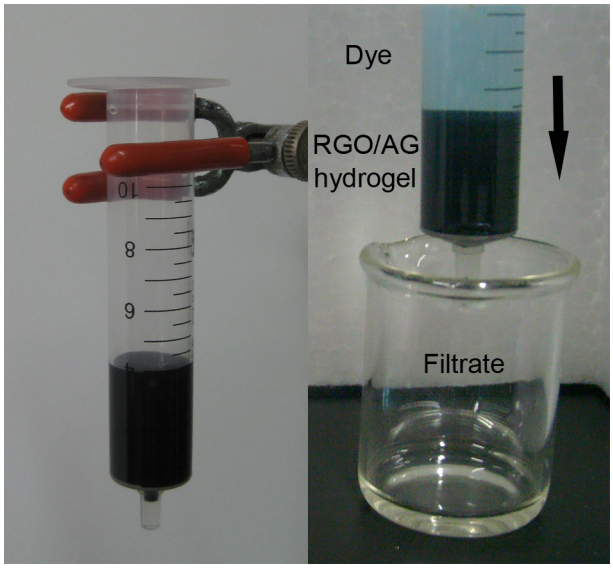

Fig. S11 Photographs of the set-up of gel-column used for the filtration and removal of organic dyes from aqueous solution.

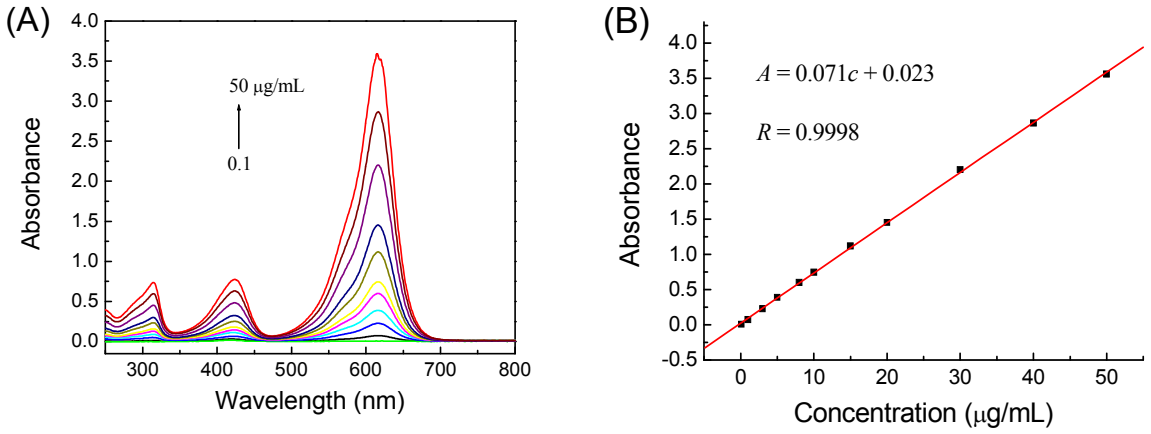

Fig. S12 (A) UV-vis absorption spectra of MG with different concentrations. (B) Linear relationship between the absorbance at 616 nm and the concentration of MG, which was used as the standard working plot to calculate the removal efficiencies of MG in the present paper.

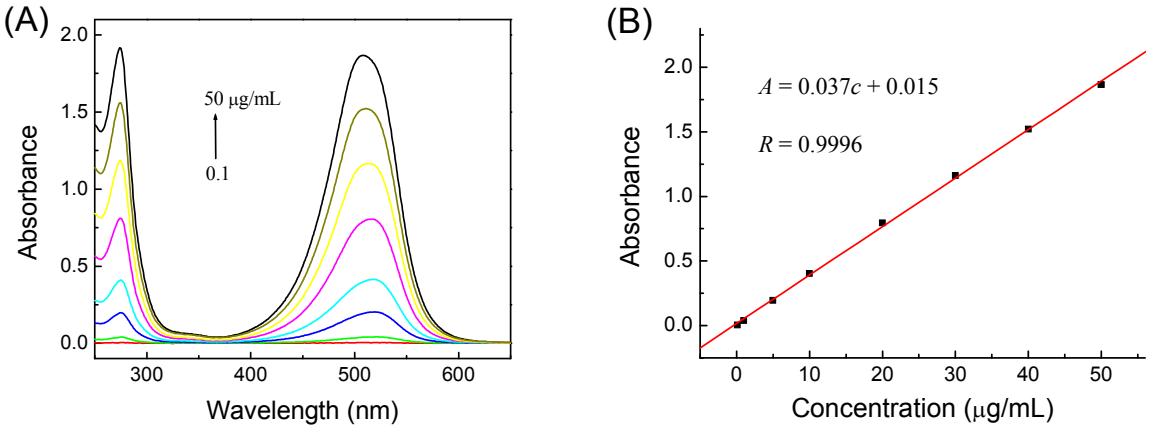

Fig. S13 (A) UV-vis absorption spectra of ST with different concentrations. (B) Linear relationship between the absorbance at 510 nm and the concentration of ST, which was used as the standard working plot to calculate the removal efficiencies of ST in the present paper.

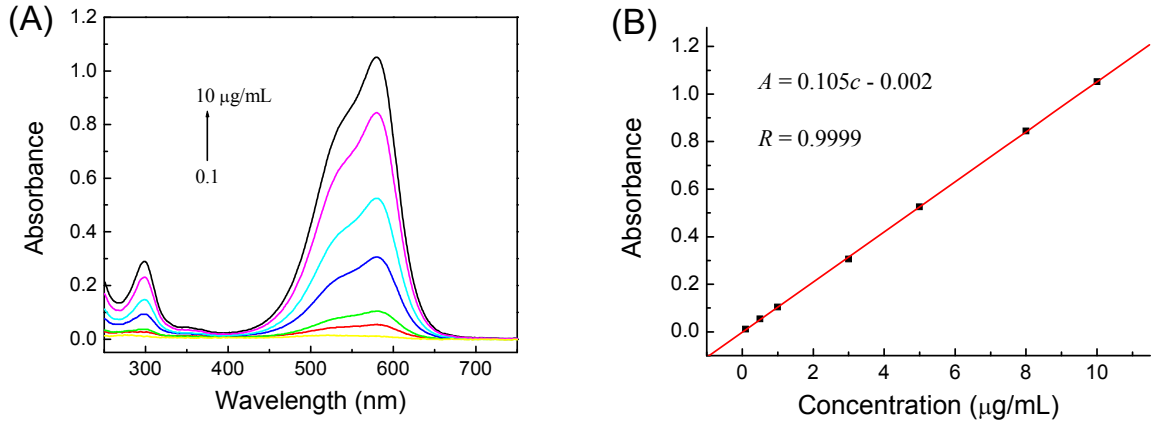

Fig. S14 (A) UV-vis absorption spectra of MV with different concentrations. (B) Linear relationship between the absorbance at 580 nm and the concentration of MV, which was used as the standard working plot to calculate the removal efficiencies of MV in the present paper.

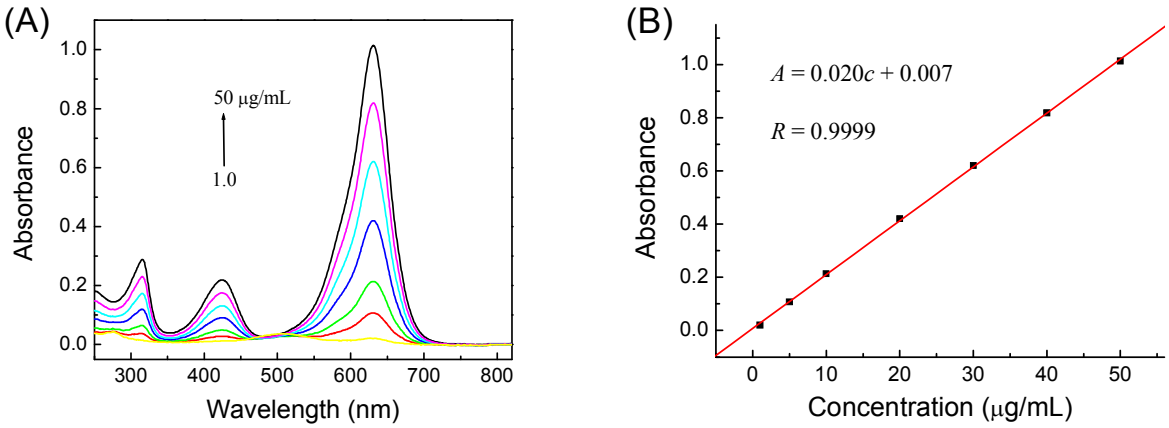

Fig. S15 (A) UV-vis absorption spectra of BG with different concentrations. (B) Linear relationship between the absorbance at 630 nm and the concentration of BG, which was used as the standard working plot to calculate the removal efficiencies of BG in the present paper.

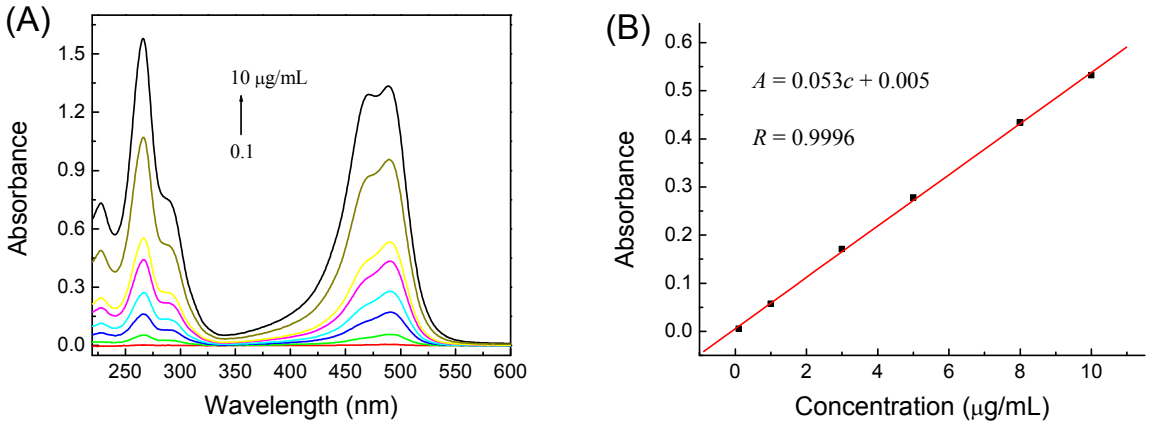

Fig. S16 (A) UV-vis absorption spectra of AO with different concentrations. (B) Linear relationship between the absorbance at 490 nm and the concentration of AO, which was used as the standard working plot to calculate the removal efficiencies of AO in the present paper.

Tab. S1 Comparison of the graphene/AG hydrogels with other kinds of materials for the maximal adsorption capability (q_m) of MG at room temperature (20 ~ 30 °C).

Adsorbent	q_m (mg/g)	Reference
RGO/AG hydrogel	242	Our work
GO/AG hydrogel	186	Our work
Carbon nanotube/polyaniline composite	13.95	[1]
Chitosan beads	93.55	[2]
Cyclodextrin-based adsorbent	91.9	[3]
Bentonite	7.72, 178.6	[4, 5]
Metal–organic framework MIL-100(Fe)	205	[6]
Activated carbon	8.27 ~ 424	[7-9]

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