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Supporting Information

3D nitrogen doped graphene gels as robust and sustainable adsorbents for dyes

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Reduced graphene oxide (rGO) was prepared by the similar method with glycol and hexanediol in the place of hexamethylenediamine and 1, 12-diaminododecane, denoted as rGO-2 and rGO-6, respectively.

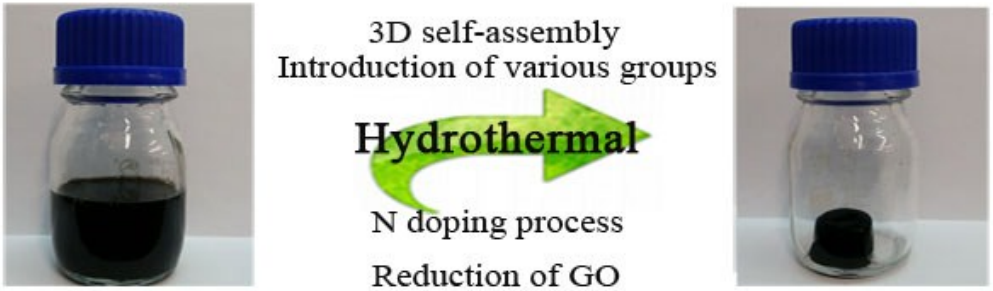

Fig. S1. Fabrication process pattern of NG gel.

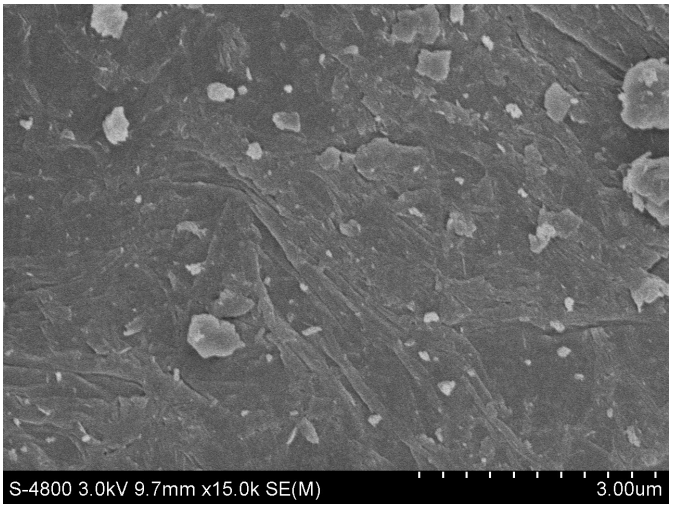

Fig. S2. SEM image of GO.

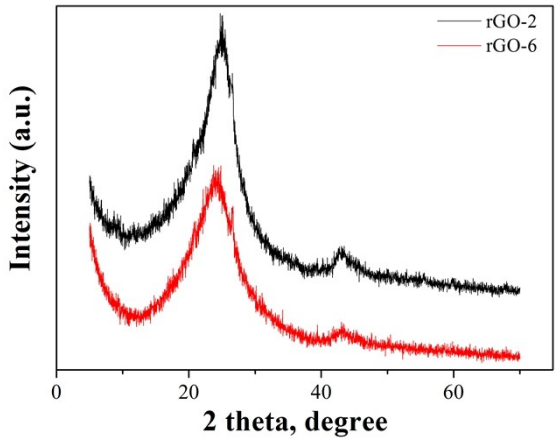

Fig. S3. XRD patterns of rGO-2 and rGO-6.

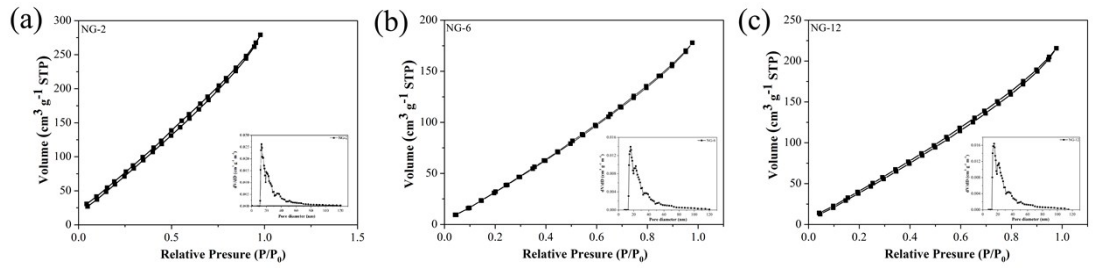

Fig. S4 N_2 adsorption-desorption isotherms and pore size distribution of NG samples: (a) NG-2; (b) NG-6; (c) NG-12.

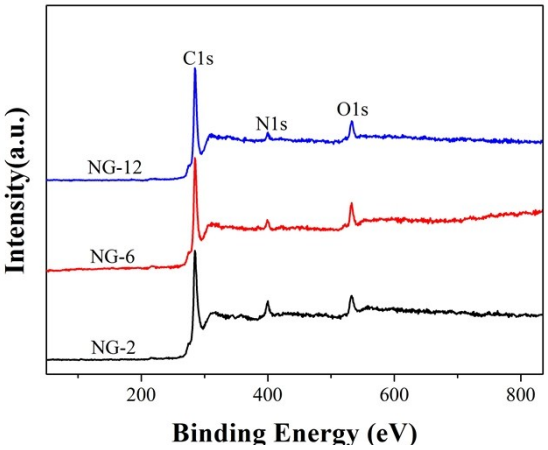

Fig. S5 XPS survey of NG samples

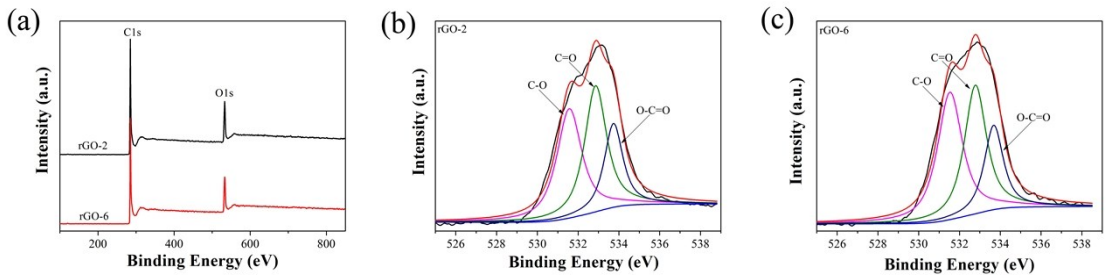

Fig. S6 High-resolution XPS spectra of (a) rGO samples and O 1s region for (b) rGO-2, (c) rGO-6.

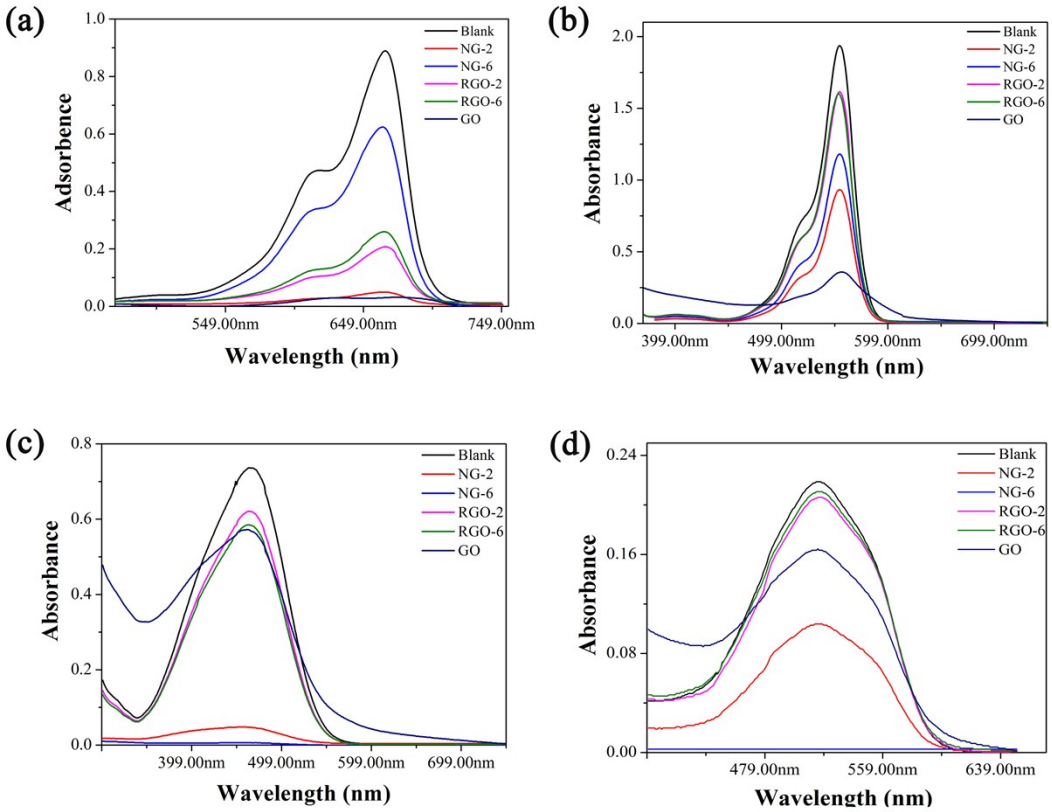

Fig. S7 UV-vis adsorption spectra of different dye solutions: (a) MB, (b) RhB, (c) MO and (d) AR after various adsorbents adsorption for 12 h.

Table S1 Comparison of adsorption values of GO, RGO and NG for adsorption of different dyes.

	MB(mg g^{-1})	RhB(mg g^{-1})	AR(mg g^{-1})	MO(mg g^{-1})
GO	124.49	98.58	24.90	19.17
RGO-2	79.19	27.43	5.77	12.81
RGO-6	73.02	28.98	3.72	16.80
NG-2	108.89	63.83	52.66	60.64
NG-6	52.92	36.84	174.86	161.31
NG-12	5.58	8.67	64.75	72.85

Table S2 Kinetics parameters of NG-2 and GO for the adsorption of MB and RhB.

		MB		RhB	
Kinetic model	Parameters	NG-2	GO	NG-2	GO
Pseudo-first-order	q_e (mg g^{-1})	110.09	124.49	64.06	98.58
	k_1 (h^{-1})	0.12	0.10	0.14	0.13
	R^2	0.9999	0.9970	0.9993	0.9988
Pseudo-second-order	q_e (mg g^{-1})	108.34	56.12	107.07	13.12
	k_2 (g (mg^{-1} h^{-1})) $\times 10^{-3}$	1.43	3.90	0.46	16.52
	R^2	0.9791	0.9641	0.9235	0.9662

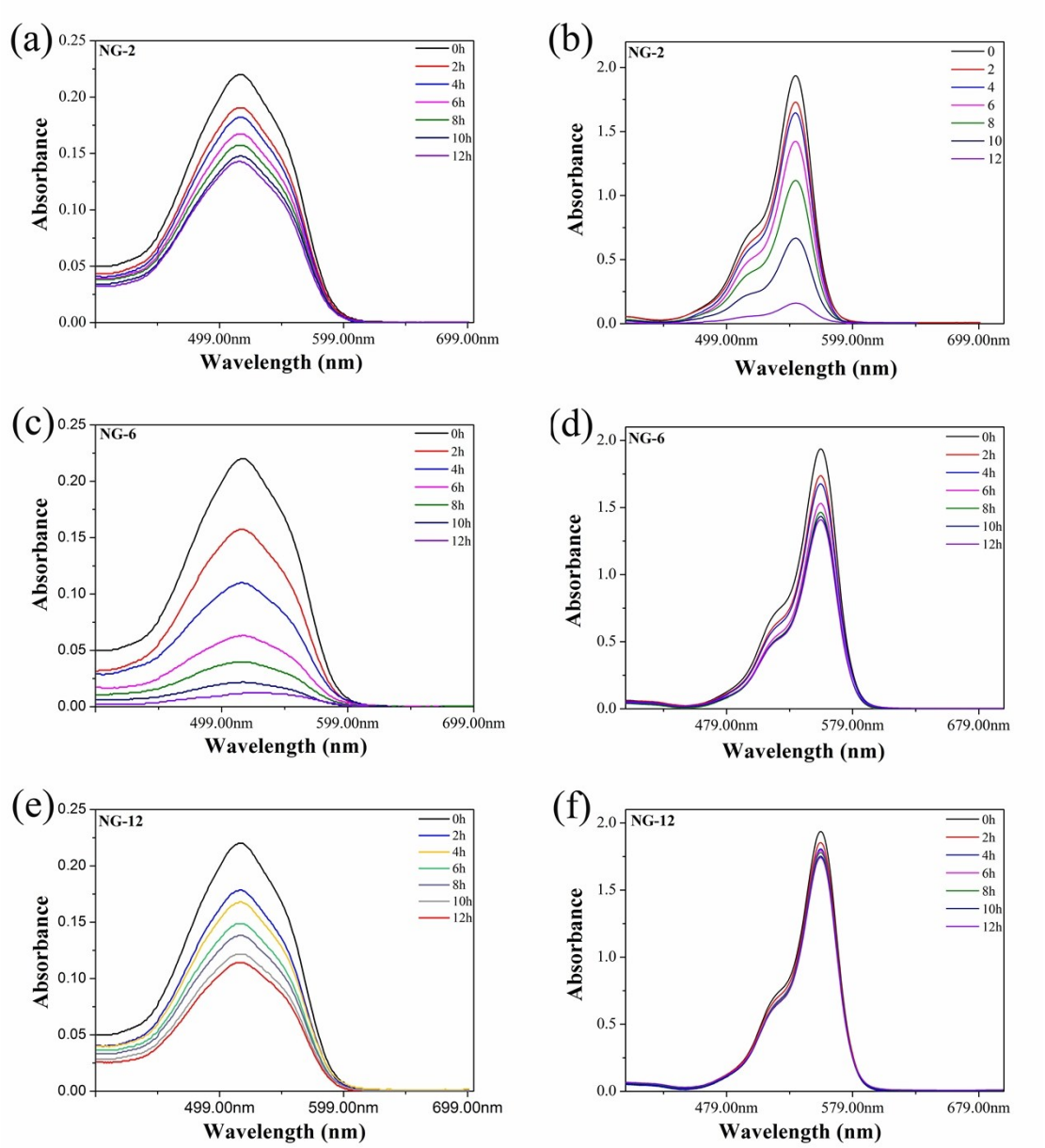

Fig. S8 UV-vis adsorption spectra of AR solutions after (a) NG-2, (c) NG-6 and (e) NG-12; RhB solutions after (b) NG-2, (d) NG-6 and (f) NG-12 adsorption for 12 h.

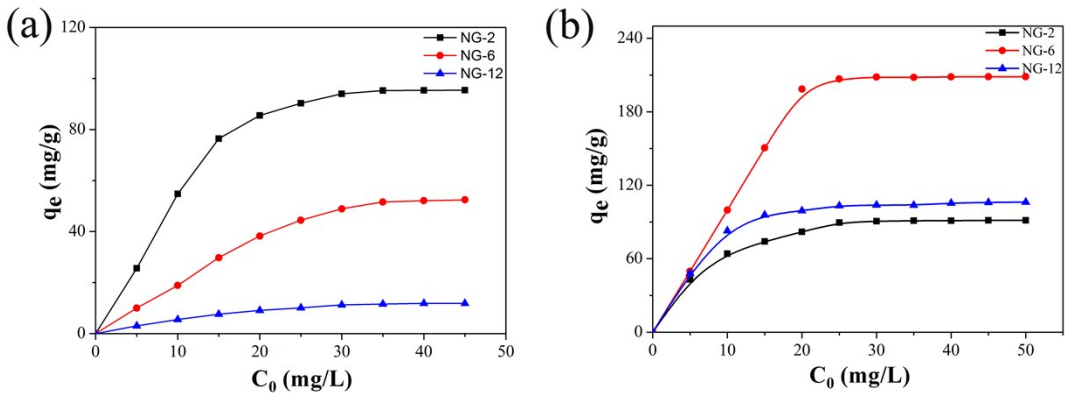

Fig. S9 Adsorption curves of (a) RhB and (b) AR on NG-2, NG-6 and NG-12.

Table S3 Langmuir and Freundlich isotherm parameters of NG-2, NG-6 and NG-12.

Isotherm model	Parameters	RhB			AR		
		NG-2	NG-6	NG-12	NG-2	NG-6	NG-12
Langmuir	q_m (mg g^{-1})	72.45	54.49	9.65	92.17	208.80	106.05
	K_L (L mg^{-1})	0.08	0.10	0.15	0.90	9.70	1.30
	R_L	0.3846	0.3333	0.2500	0.0528	0.0005	0.0372
	R^2	0.9985	0.9992	0.9987	0.9985	0.9940	0.9966
Freundlich	K_F (mg g^{-1}) ($L\ mg^{-1}$)$^{1/n}$	1.52	2.87	15.82	31.67	262.42	40.64
	n	4.75	3.45	0.97	2.56	7.50	3.07
	R^2	0.9634	0.9816	0.9978	0.8892	0.8141	0.8164

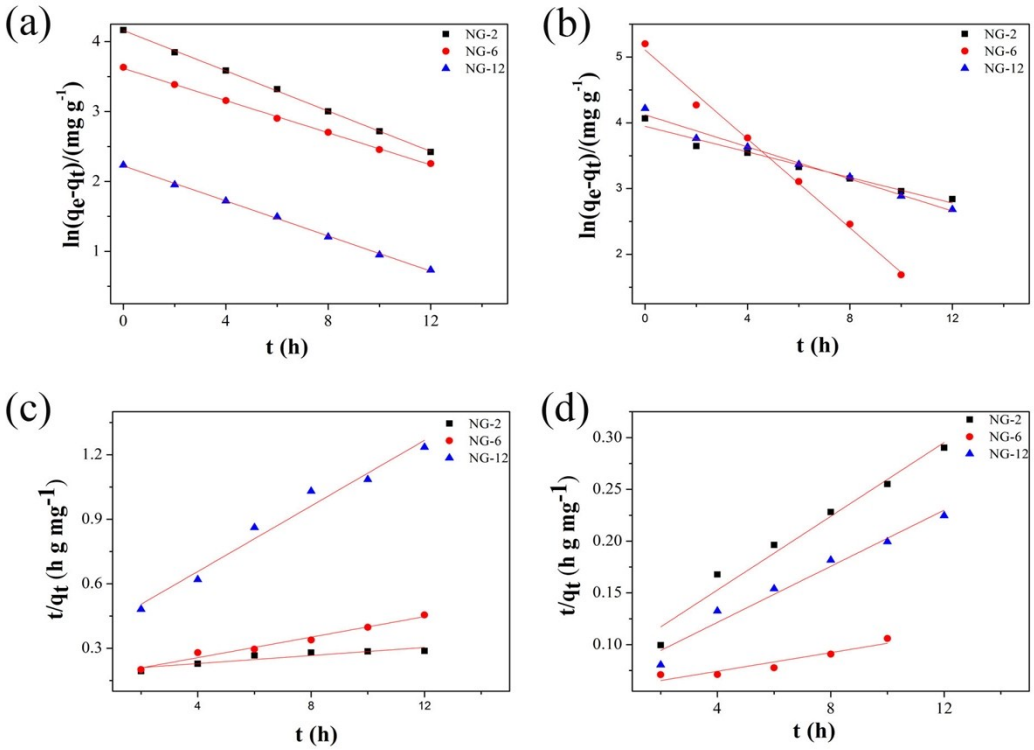

Fig. S10 Pseudo-first-order kinetic plots with (a) RhB, (b) AR on NG-2, NG-6 and NG-12; pseudo-second-order kinetic plots: (c) RhB, (d) AR on NG-2, NG-6 and NG-12.

Table S4 Kinetics parameters of NG-2, NG-6 and NG-12 for the adsorption of RhB and AR.

		RhB			AR		
Kinetic model	Parameters	NG-2	NG-6	NG-12	NG-2	NG-6	NG-12
Pseudo-first-order	q_e (mg g^{-1})	64.06	37.26	9.24	53.96	178.34	64.94
	k_1 (h^{-1})	0.14	0.12	0.13	0.10	0.35	0.13
	R^2	0.9993	0.9989	0.9988	0.9970	0.9993	0.9982
Pseudo-second-order	q_e (mg g^{-1})	107.07	41.95	13.12	56.12	222.72	73.75
	k_2 (g (mg^{-1} h^{-1})) $\times 10^{-3}$	0.46	3.53	16.52	3.90	0.36	2.73
	h_0	5.27	6.21	2.84	12.28	17.86	14.85
	R^2	0.9235	0.9887	0.9662	0.9641	0.8545	0.9600

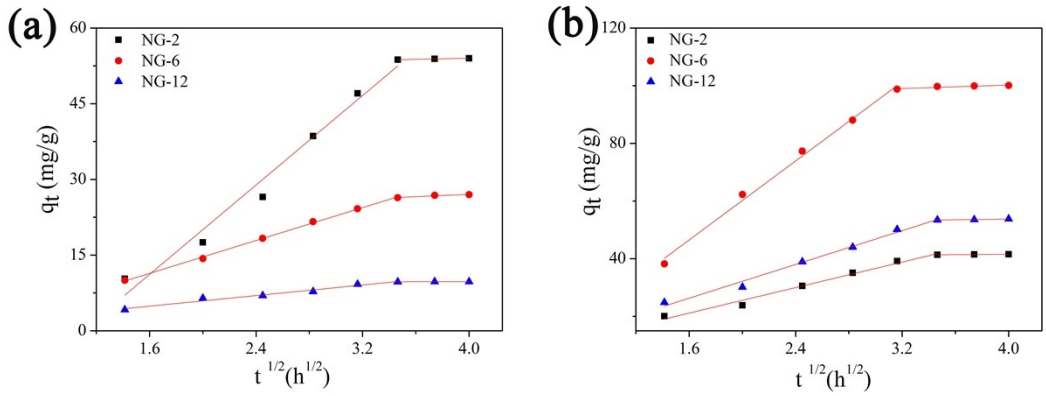

Fig. S11 Intra-particle diffusion kinetics plots with (a) RhB and (b) AR on NG-2, NG-6 and NG-12.

Table S5 Intra-particle diffusion model parameters for adsorption of RhB and AR .

	RhB			AR		
Parameters	NG-2	NG-6	NG-12	NG-2	NG-6	NG-12
k_i (mg (g $h^{1/2})^{-1}$)	21.73	9.47	2.62	11.06	35.06	14.63
C (mg g^{-1})	23.52	1.66	0.69	3.44	15.53	2.90
R^2	0.9734	0.9656	0.9677	0.9835	0.9515	0.9872