

Supporting Information

Synchronous, efficient and fast removal of phosphate and organic matter by carbon-coated lanthanum nanorods

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Experimental section

Digestion method

(1) Boil 0.01 g of products with 10 mL of aqua regia and 2 mL of HClO_4 at 120 °C until the products were dissolved; (2) After cooling, add 1mL HClO_4 into the solution, evaporate at 160 °C until the residual liquid volume was approximately 1 mL; (3) After cooling, dilute the solution with 2% HNO_3 (MOS grad) to 100 mL.

HA stock preparation and determination

HA stock solution was prepared by dissolving 1 g of HA solid in 500 mL of 0.1 M NaOH, followed by filtration with 0.45 μm glass fiber filters, and was stored at 4 °C for later use. The HA stock solution was diluted in gradient and the amounts of HA were measured by TOC analyzer (Multi N/C 2100, Analytik-Jena, Germany) and UV-vis spectrophotometer at the same time. The linear regressions between the values of UV254 absorbance at 254 nm and TOC (TOC-UV254) and between the TOC values and the corresponding multiplicative inverse of dilution ratios were done. And the equations of linear regression were obtained (TOC-1/dilution ratios). In the text, the target concentration solution (mg TOC/L) and the practical concentration (mg TOC/L) were acquired by the linear regression equations of TOC-1/dilution ratios and TOC-UV254, respectively. The results were shown in Figure S1.

Figures

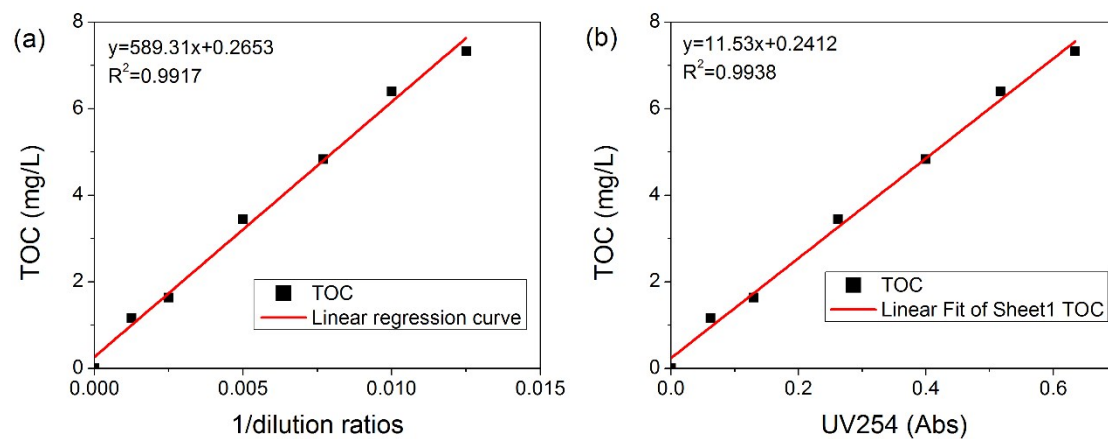


Figure S1. (a) Relationship between the TOC values and the corresponding multiplicative inverse of dilution ratios. (b) Relationship between the TOC values and the UV254 absorbance at 254 nm.

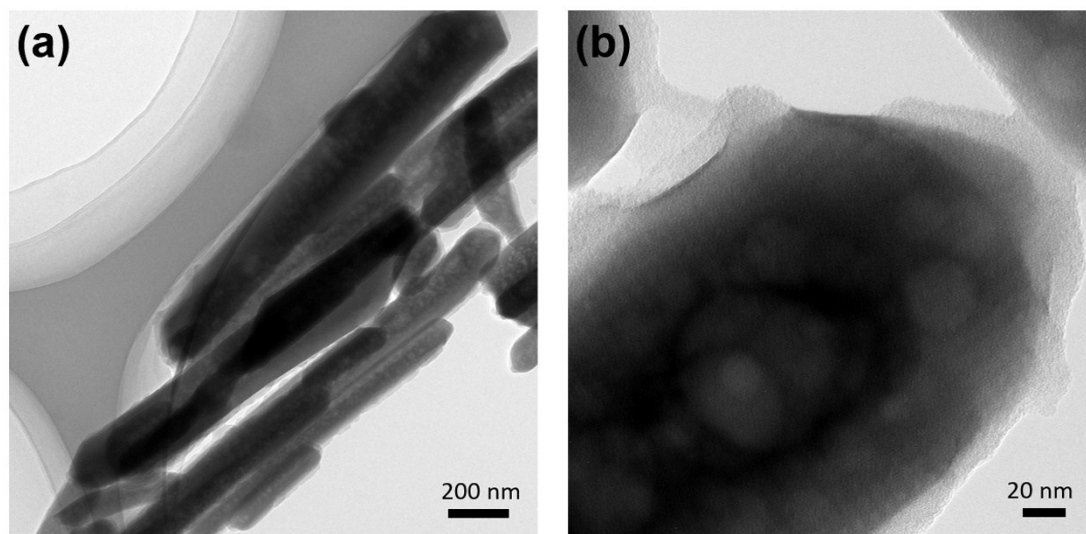


Figure S2. (a) and (b) are the TEM images of G-La-MOF (C-La-MOF before carbonization) at various magnification.

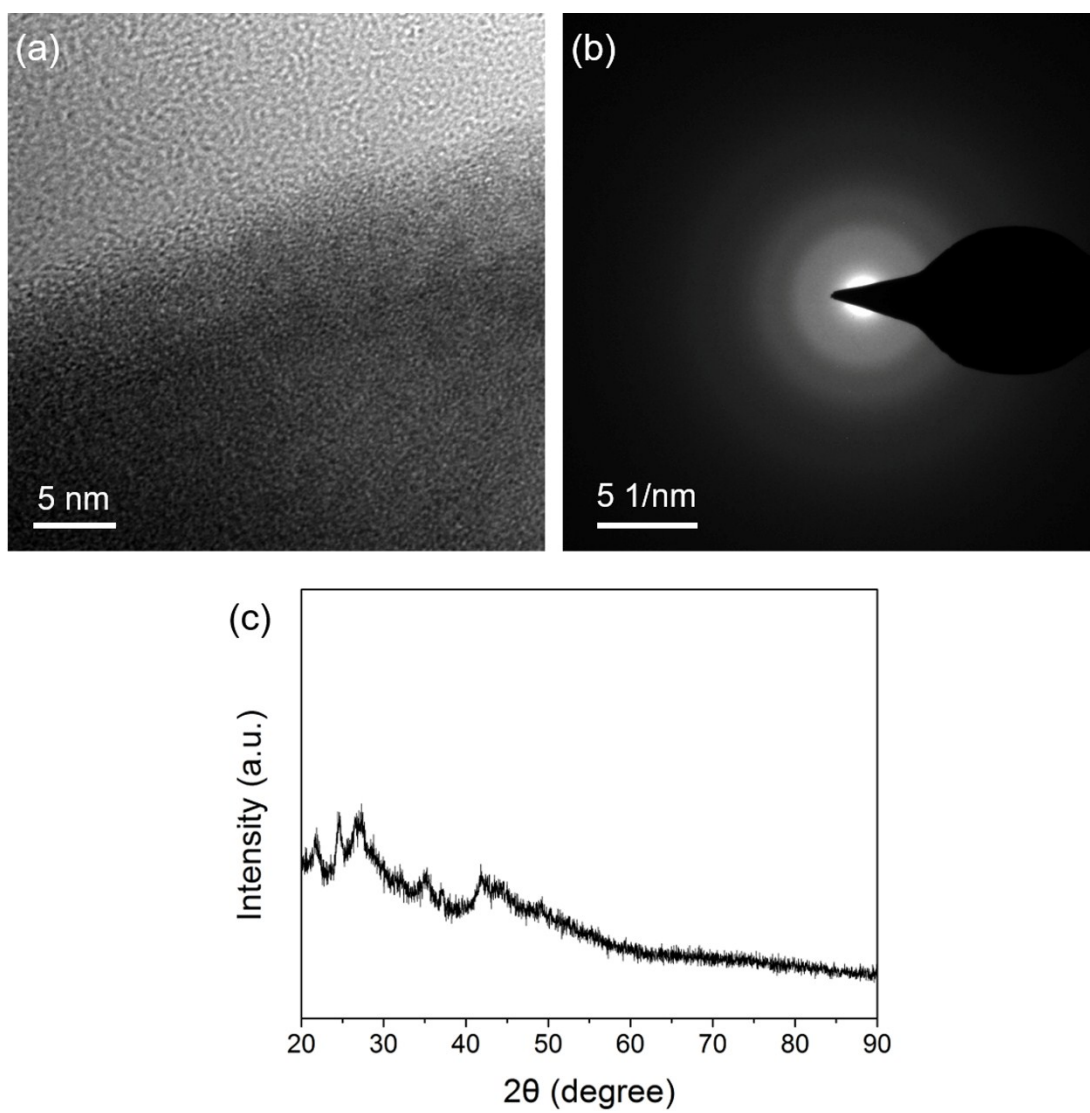


Figure S3. (a) HRTEM image of C-La-MOF. (b) SAED pattern of C-La-MOF. (c) XRD pattern of C-La-MOF.

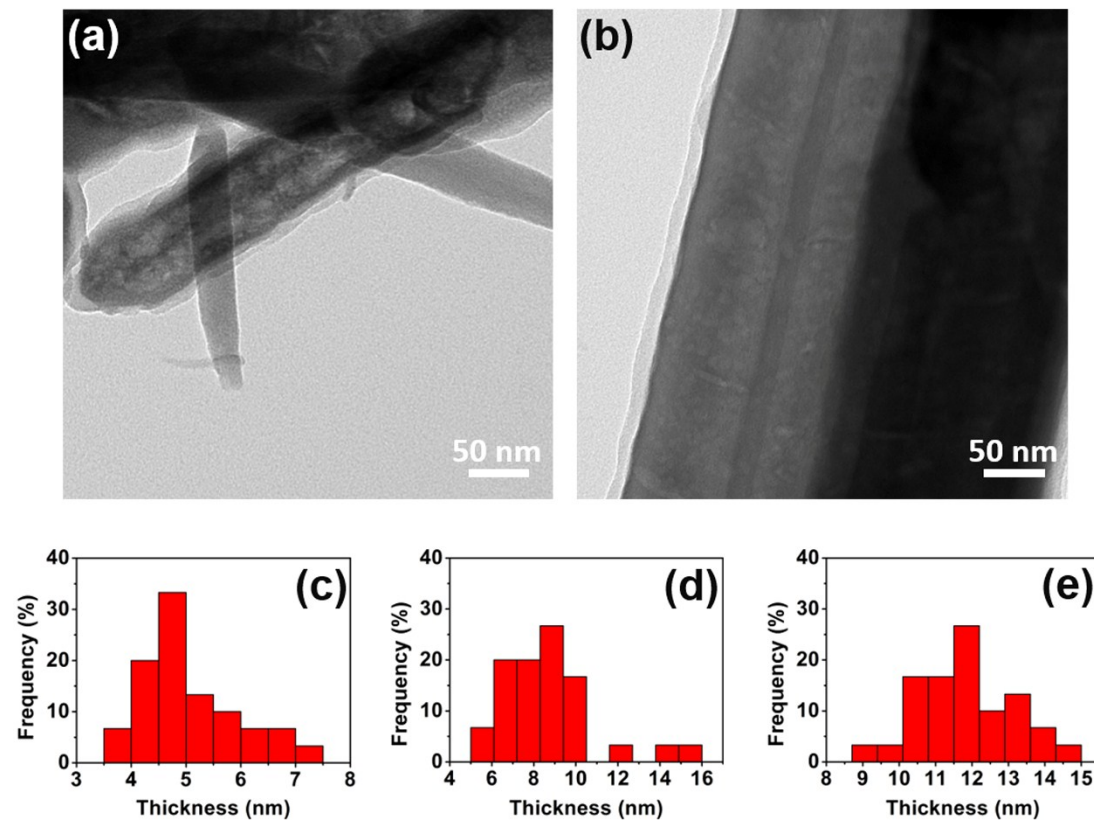


Figure S4. (a) and (b) are the TEM images of C-La-MOF10 and C-La-MOF12, respectively. (c-e) are the thickness distribution of C-La-MOF, C-La-MOF10 and C-La-MOF12, respectively.

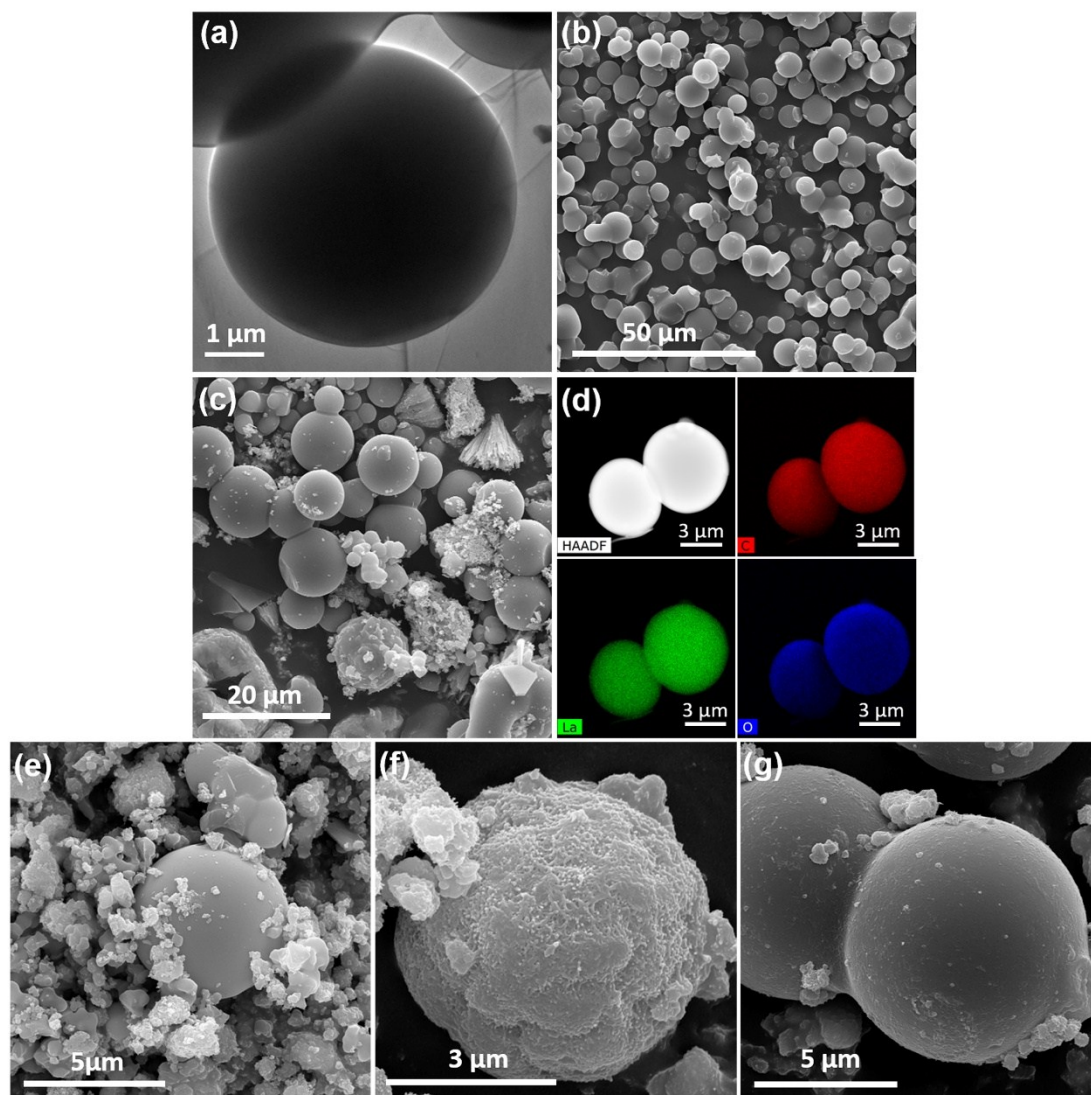


Figure S5. (a) and (b) are TEM and SEM images of C-La, respectively. (c) SEM image of C-La-MOF-500. (d) High angle annular dark field (HAADF) image of C-La-MOF-500 and the corresponding elemental mapping of C, O and La. (e) SEM image of C-La₂O₃. (f) and (g) are SEM images of C-La₂O₃ after phosphate adsorption.

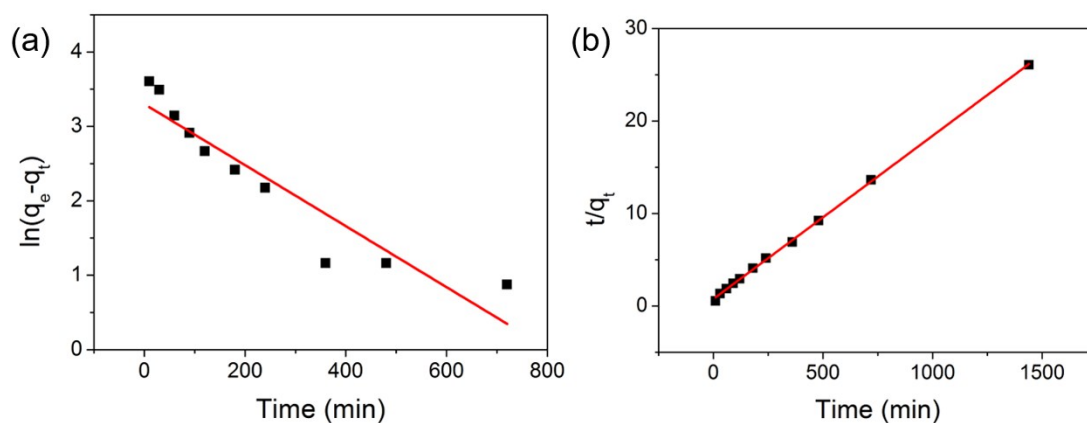


Figure S6. (a) and (b) are the pseudo-first-order model and pseudo-second-order model, respectively, for the phosphate adsorption onto C-La-MOF (initial P concentration = 50 mg P/L).

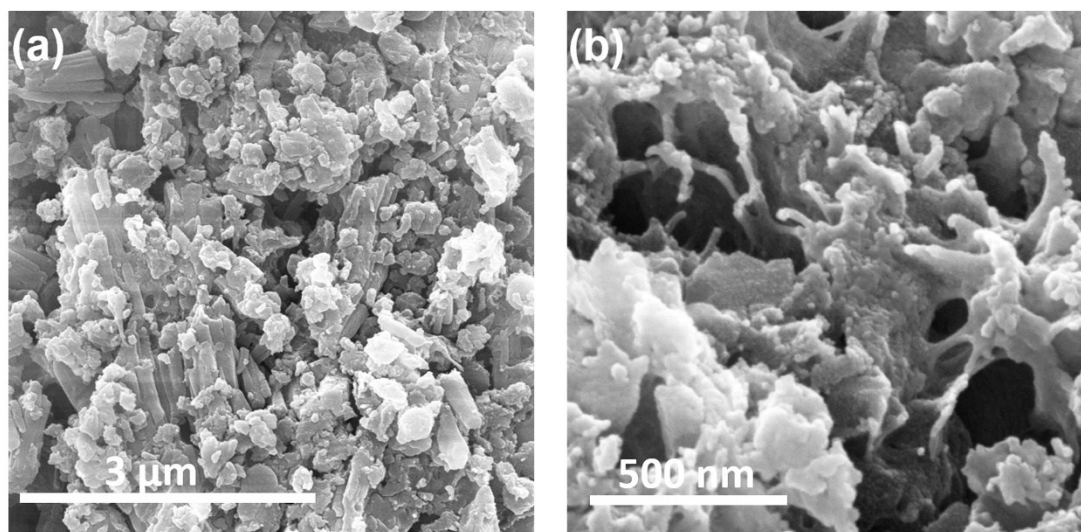


Fig. S7. (a) and (b) are the SEM images of C-La-MOF after capturing phosphate at various magnification. The surface of La-MOF-500 became rough.

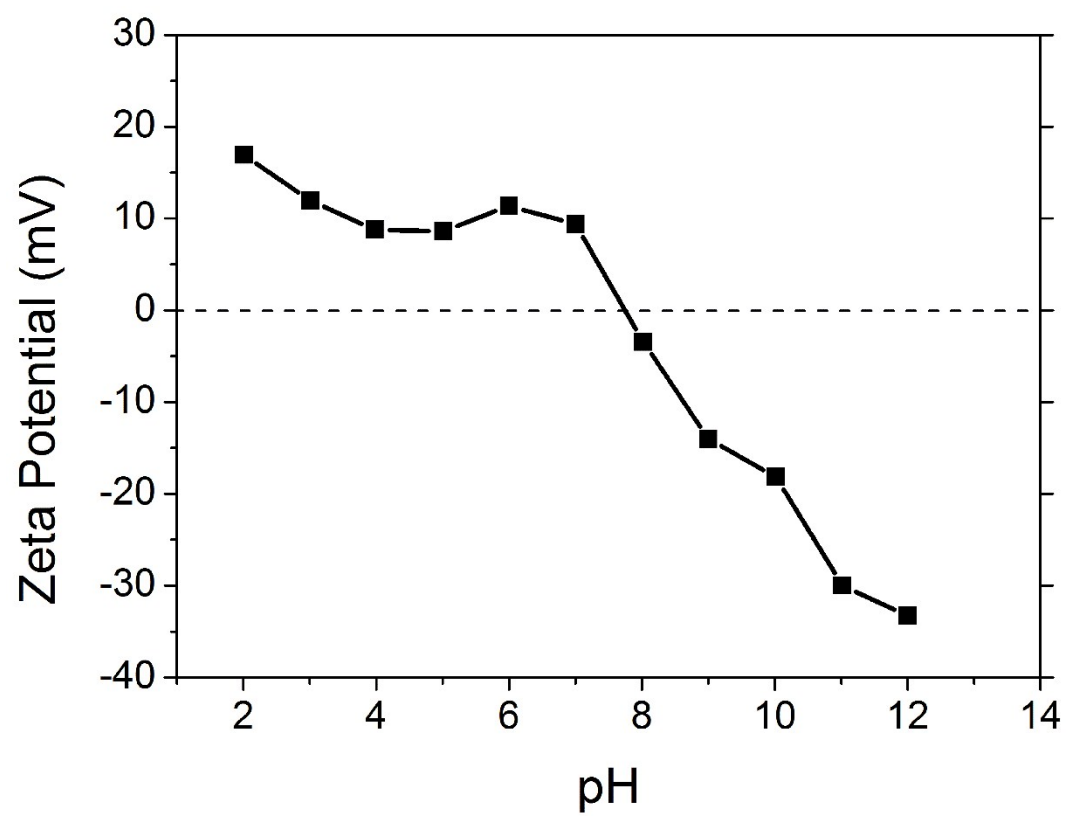


Fig. S8. Zeta potentials of C-La-MOF at pH 2~12.

Tables:

Table S1. Equilibrium isotherm model parameters of phosphate adsorption by C-La-MOF at 25 °C.

Langmuir			Freundlich		
q_m (mg P/g)	K_L (L/mg)	R^2	$1/n$	K_F (mg/g)	R^2
58.97	1.37	0.569	0.132	37.41	0.911

Table S2. Kinetics parameters of phosphate adsorption over C-La-MOF at 25 °C.

Pseudo first-order kinetics			Pseudo second-order kinetics		
k_1 (1/min)	q_e (cal) (mg P/g)	R^2	k_2 (g/mg·min)	q_e (cal) (mg P/g)	R^2
0.0041	27.12	0.870	0.0004	56.72	0.999

Table S3. Turbidity of solutions with C-La-MOF at different pH.

pH	Turbidity after sedimentation for 20 min (NTU)	Turbidity after further filtration (NTU)
2	8.34	0.092
3	2.98	0.042
4	2.89	0.003
5	5.98	0.048
6	5.37	0.048
7	8.04	0.035
8	13.27	0.405
9	12.87	0.115
10	95.87	0.035
11	31.67	0.195
12	9.76	0.748