

Electronic Supplementary Information

for:

Facile synthesis of ultralong hydroxyapatite nanowire using wormlike micelles as soft templates

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Synthesis of the hydroxyapatite/carbon composite adsorbent

0.1g hydroxyapatite was mixed with 80 ml deionized water and 10.00 ml benzyl alcohol. The hydroxyapatite dispersion was prepared after ultrasonic agitation at 40 kHz (300 W) for 6 h. 30.00 ml dispersion was mixed with 88.0 g of rice husk biomass carbon after stirred for 30 min, and then slowly added with 50 ml Polyvinyl alcohol (PVA-124) aqueous solution. The pellet composite adsorbent was synthesized after mechanical kneading and drying at 60 °C for 5 h. The carbon adsorbent was synthesized with the same progress without adding hydroxyapatite dispersion.

Adsorption experiments

(1) Effect of solution pH

The pH value of 50 mg/L methyl orange (MO) solution was adjust to 3, 4, 5, 6 and 7 with 1.00 mol/L NaOH or 1.00 mol/ L HCl, respectively. 0.30 g adsorbent was added into 30.00 ml MO solution in a constant temperature oscillator, and vibrate at temperature 50 °C for 4 h at 160 rpm. After the adsorption, the concentration of MO solution was determined by the UV-Vis spectrophotometer at 465 nm.

The adsorption equilibrium concentration of MO was calculated by the following equation:

$$A = \varepsilon \cdot b \cdot C_e$$

Where A is the absorbance of MO solution, ε is molar absorptivity of MO, b is the thickness of the cuvette, C_e is the adsorption equilibrium concentration of MO.

The unit adsorption amount of MO (q_e) is calculated according to following formula:

$$q_e = (C_0 - C_e) \cdot V/W$$

Where C_0 is the initial adsorption concentration of MO, V is the volume of solution, W is the mass of adsorbent.

The removal efficiency (P) of MO is calculated according to following equation:

$$P = (C_0 - C_e)/C_0 \cdot 100\%$$

(2) Effect of solution temperature

The pH value of 50 mg/L methyl orange (MO) solution was adjusted to 4 with 0.10 mol/L NaOH. 0.30 g adsorbent was added into 30.00 ml MO solution in a constant temperature oscillator, and vibrates for 4 h at 160 rpm at temperature 20, 30, 40, 50, 60 °C, respectively. After the adsorption, the concentration of MO solution was determined by the UV-Vis spectrophotometer at 465 nm. The removal efficiency of MO was calculated by the above formula.

(3) Effect of contact time

The pH value of 50 mg/L methyl orange (MO) solution was adjusted to 4 with 0.10 mol/L NaOH. 0.30 g adsorbent was added into 30.00 ml MO solution in a constant temperature oscillator, and vibrates at temperature 50 °C for 60 min, 120 min, 180 min, 240 min, 300 min at 160 rpm, respectively. After the adsorption, the concentration of MO solution was determined by the UV-Vis spectrophotometer at 465 nm. The removal efficiency of MO was calculated by the above formula.

The quasi-first-order kinetic equation was calculated as follow:

$$\ln(q_e - q_t) = \ln q_e - k_1 \cdot t$$

Where q_e and q_t are the adsorption capacity at t and equilibrium state, respectively. k_1 is the first order adsorption rate constant.

The quasi-second-order kinetic equation was calculated as follow:

$$t/q_t = 1/(k_2 \cdot q_e^2) + t/q_e$$

where k_2 is the second order adsorption rate constant.

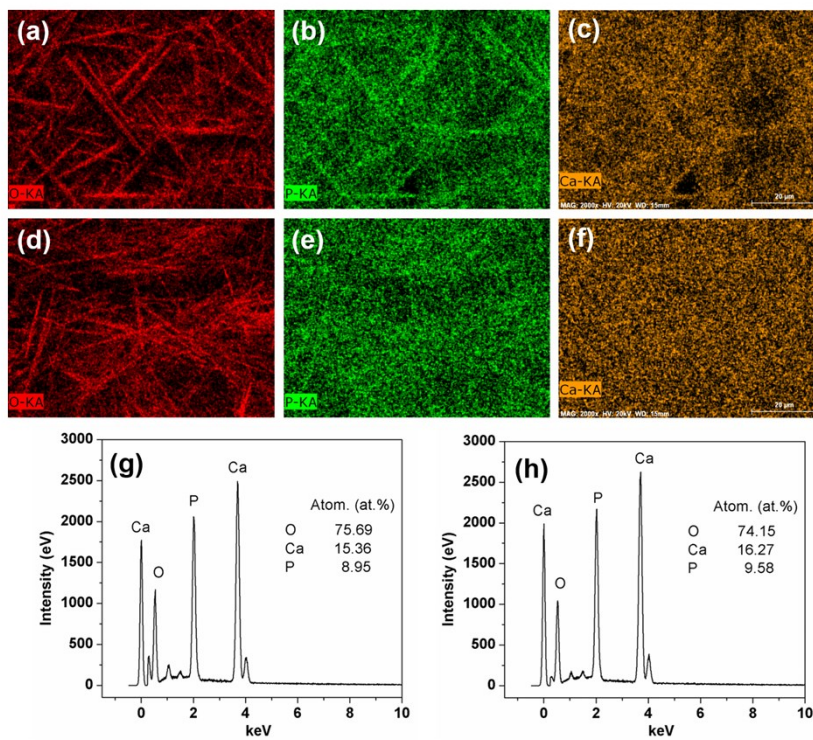


Fig. S1 Elemental mapping (a-c) and SEM-EDS (g) of HAP1# sample, and elemental mapping (d-f) and SEM-EDS (h) of HAP2# sample

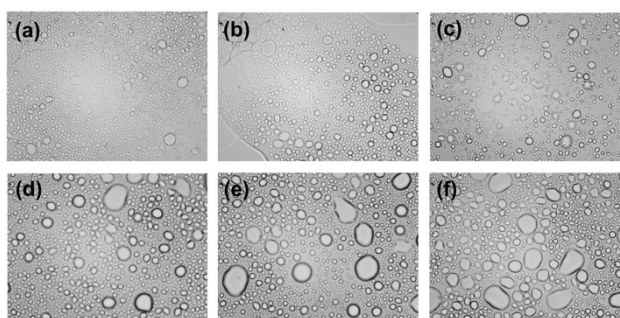


Fig. S2 Optical microscope images (200× magnification) of the HAP1# solution system with dropwise adding of CaCl₂ aqueous solution. For attaining better monitor the reaction process, the photos taken every five minutes.

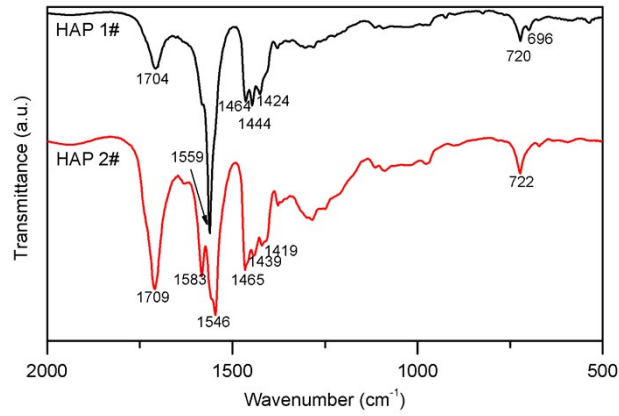


Fig. S3 The Fourier transform infrared spectra for HAP1# and HAP2# precursor of reaction process.

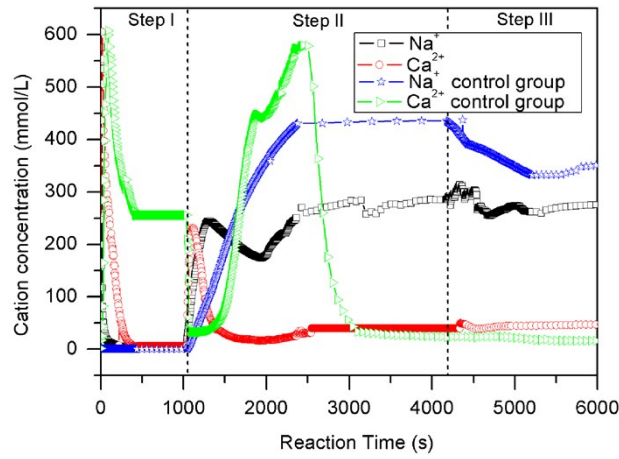


Fig. S4 The variation of cation concentration in reaction process for HAP1#. For comparison, the reaction solution of control group was exchanged to deionized water.

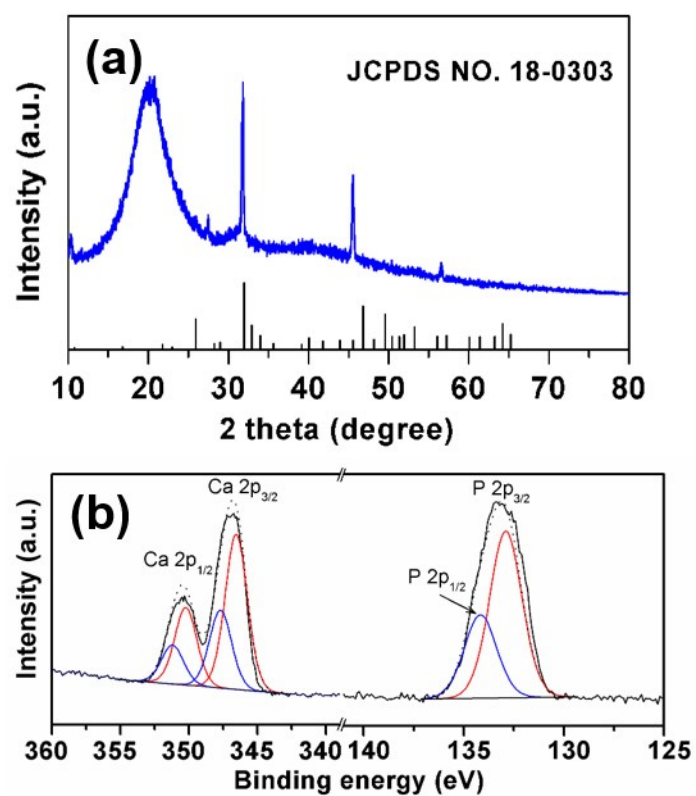


Fig. S5 The (a) XRD pattern and (b) XPS spectra of Ca 2p and P 2p of precursor synthesized by oleic acid as reactant. The binding energy of the Ca 2p_{3/2} peak center at 346.5 eV was for calcium phosphate, and the Ca 2p_{3/2} peak center at 347.7 eV was for calcium oleate.

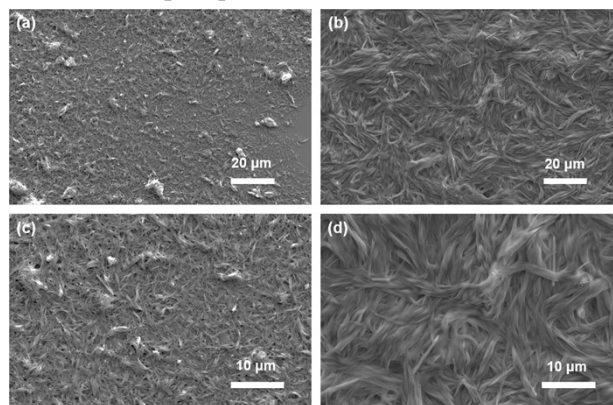


Fig. S6 The SEM image of HAP synthesized by (a, c) sodium oleate as reactant with pH=8.0 (HAP4#), (b, d) oleic acid as reactant with pH=8.0 (HAP5#).

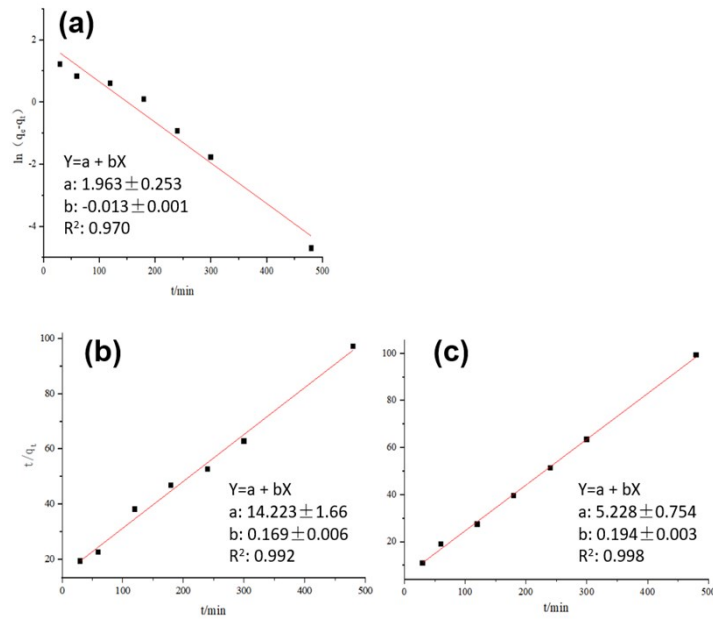


Fig. S7 The (a) pseudo-first-order (PFO) and (c) pseudo-second-order (PSO) adsorption kinetic models for methyl orange (MO) adsorption on hydroxyapatite/carbon (HAP1#/C) composite adsorbent. The (b) PSO adsorption kinetic models for MO adsorption on carbon.