1 **Supplementary Material**

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3 # Synthesis of polyacrylonitrile nanoflowers and its controlled

4 # pH-sensitive drug release behavior

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1 Characterizations:

1.1 FTIR

Fourier transform infrared (FTIR) spectra of PAN nanoflowers in KBr disc form were recorded on FTIR spectrometer (360SX, Nicolet, Minnesota) from 400 to 4000 cm^{-1} with a resolution 4 cm^{-1} and 100 scans.

1.2 SEM analysis

The morphology of the PAN nanoflowers was investigated by scanning electron microscopy (SEM) (JSM-6460LV, JEOL, Japan).The nanoflowers were coated with gold for enhancing conductivity before scanning.

1.3. TEM analysis

The size and morphology of PAN nanoflowers were characterized by transmission electron microscope (TEM, H-7650, Hitachi Inc.). The sample for TEM analysis was obtained by placing a drop of the nanoflowers dispersed ethyl solution onto a copper micro-grid and evaporated in 20 ^{o}C.

1.4. XRD

The structure of the PAN nanoflowers was characterized by XRD (Philips, Holland). The X-ray diffraction patterns were taken from $10^{o}$to 60° (2θ value) using Cu Ka radiation with an intensity ratio(a_1/a_2) = 0.5 and wavelengths of 1.54439 and 1.54056 °A, respectively.

2. Swelling ratio

The swelling properties of PAN(TBP), PAN(MA), PAN(EA) and P(NA-St) nanoflowers were studied in different buffer solutions with pH 1.0, 6.8 and 7.4.

1 Nanoflowers of PAN with a known weight (W_o) were immersed in buffer solution at

2 37°C. The nanoflowers were then removed from the buffer solution at predetermined

3 intervals and the excess solution was removed from the surface with a wet filter paper

4 and weighed. The swelling ratio(SR) can be calculated as a function of time:

5 　　　%Swelling ratio(SR)= $[(W_t - W_o)/ W_o] \times 100\%$ 　　　　　(1)

6 where, W_o was the dried weight of PAN nanoflowers before immersed in buffer

7 solution, W_t was the weight of nanoflowers at time t after immersed in buffer solution.

8 **3. Adsorption and selectivity experiments**

9 　　100mg PAN nanoflowers were soaked in the BSA solution with the

10 concentration range from 0.2mg/ml to 1.8mg/ml for 12 hours to the adsorption

11 equilibrium at room temperature, and then 0.4ml supernatant was withdraw and

12 determined with UV-vis(λ max= 279 nm) after dilution to a certain volume. The

13 equilibrium binding capacity of BSA(Qe) was calculated according to the formula (2)

14 as follows.

15 　　$Q_e = \dfrac{V(C_0 - C_e)}{m}$ 　　　　　　　　　(2)

16 Where Q_e denotes the equilibrium binding capacity of BSA (mg/g), C_0 is the initial

17 concentration solution(mg/L); C_e is the substrate concentration of the solution after

18 adsorption equilibrium(mg/L); V and m represent the volume of the adsorbed solution

19 (ml) and the mass of the PAN nanoflowers(g).

20 **3 The release rate of BSA in mimicking stomach acidic fluids.**

21 1.7778g proteases was dissolved in 100ml buffer solution with pH 1.0. And then 30

22 ml of the above mixture was transferred to the covered triangle bottle with pipette.

1   The drug loading PAN nanoparticles (0.5g) was dissolved in the above covered

2   triangular bottle. Five copied the above solution was prepared. Then, the above

3   triangle bottle was oscillated for a certain time in the table constant temperature

4   shaker at a frequency of 80 times /min. After centrifugation, the substratum

5   precipitation was scattered into 100ml phosphate buffer solution at pH 7.4 to release

6   for 30h. The kinetics of drug release were recorded using a dissolution tester RCZ-1

7   A coupled with an UV Hewlett Packard spectrophotometer for detection of BSA

8   (λ_{max}= 279 nm). Therefore, the concentration of BSA broken by proteases in

9   mimicking stomach acidic fluids from the formula (3).

$$Q = \frac{c_0 - c_1}{c_0} \times 100\%$$

10   (3)

11   Where Q donates the drug release rate of BSA broken by proteases in mimicking

12   stomach acidic fluids, C_0 is the drug loading concentration of BSA in the pH 1.0

13   buffer solution; C_1 is the concentration of BSA after drug release in the pH 7.4

14   phosphate buffer solution.

15   **4. In vitro controlled release of BSA**

16   Nanoparticles were immersed in 20 ml of 10 mg BSA in sodium hydroxide

17   solution for 12 h at 37°C, and then were centrifuged at 10000rpm for 10min and dried

18   under vacuum. Nanoparticles loading with BSA were suspended in 40 ml 0.1mol/ l

19   phosphate buffer solution at different pH (1.0, 6.8, 7.4). The entire system was

20   maintained at 37 ℃±0.5°C with gently shaking. Periodically, 0.4 ml of the release

21   medium was withdrawn and the supernatant after separation was stored at 4 ℃ for

22   UV-vis analysis. The total mass of released BSA (*Q*) at each moment of the

1   experiment was calculated as formula (4), taking into account the aliquots taken. The

2   kinetics of drug release were recorded using a dissolution tester RCZ-1 A coupled

3   with an UV Hewlett Packard spectrophotometer for detection of BSA   (λ_{max}= 279

4   nm) and presented using the diffusion equation as the ratio of the amount of drug

5   released at the time t(M_t)/ the total amount (M_{inf}) of drug released from the tablet.

6   $$Q = \frac{C_n \times V_0 + V_i \sum_{i=1}^{n-1} C_i}{m} \times 100\% \tag{4}$$

7   Where Q, C_n, C_i, V_0 and m denote the cumulative release rate (%), the mass

8   concentration of drug release medium after the n-th sampling (mg/ml), the mass

9   concentration of drug release after the i-th sampling (mg/ml), the volume of the

10 release medium (ml), and the total drug loading (mg), respectively.

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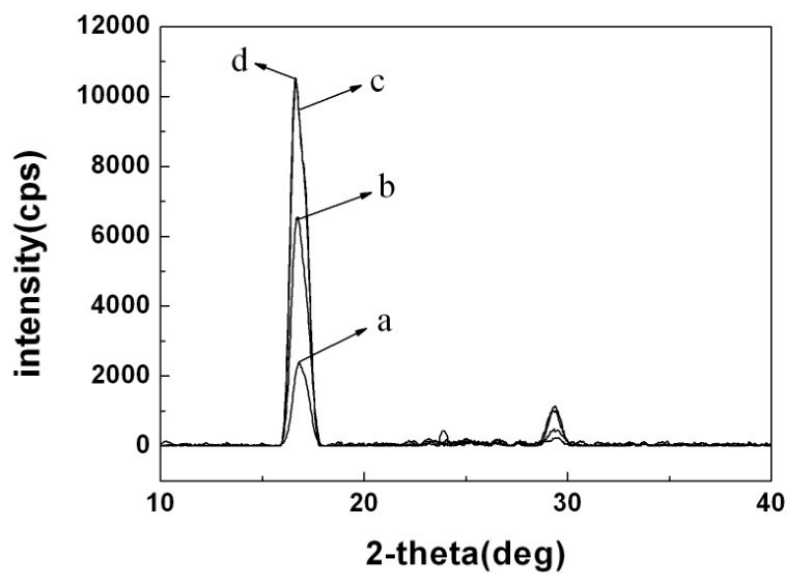12

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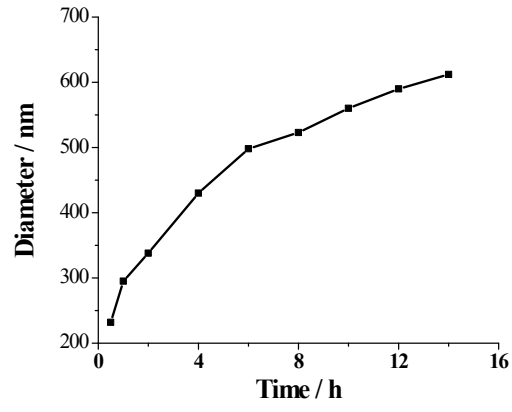
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4   Figure S1 The size growth of PAN nanoflowers with time
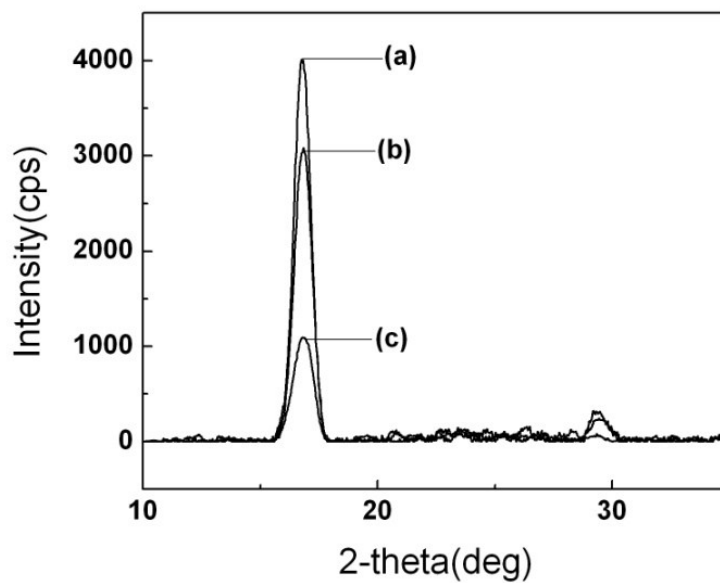
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3　　　　　　Figure S2 XRD patterns of PAN nanoparticles in different midium

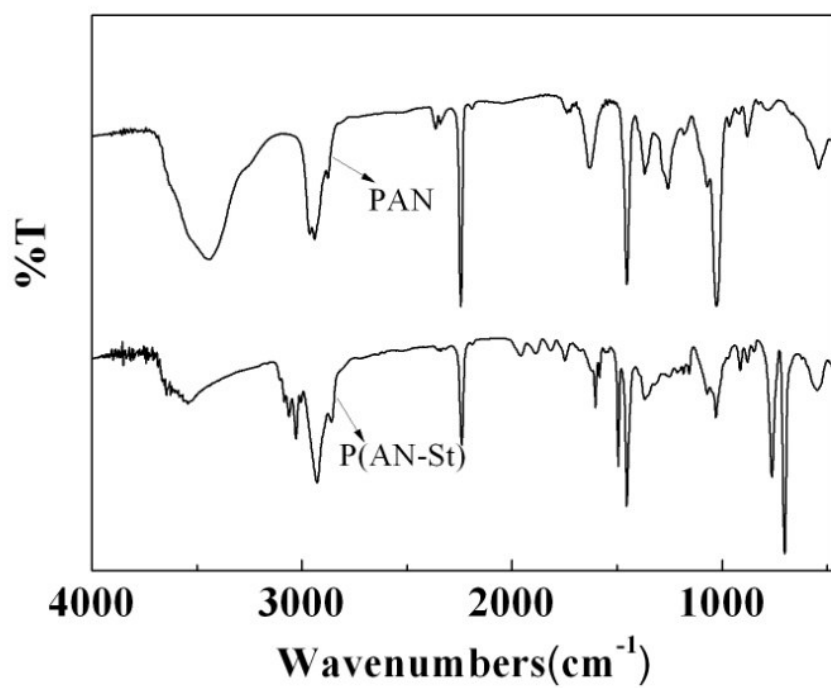4　　　　a) methyl acetate, b) ethyl acetate, c) butyl acetate, d) isoamyl acetate

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3 Figure S3 XRD patterns of PAN nanoparticles at different styrene

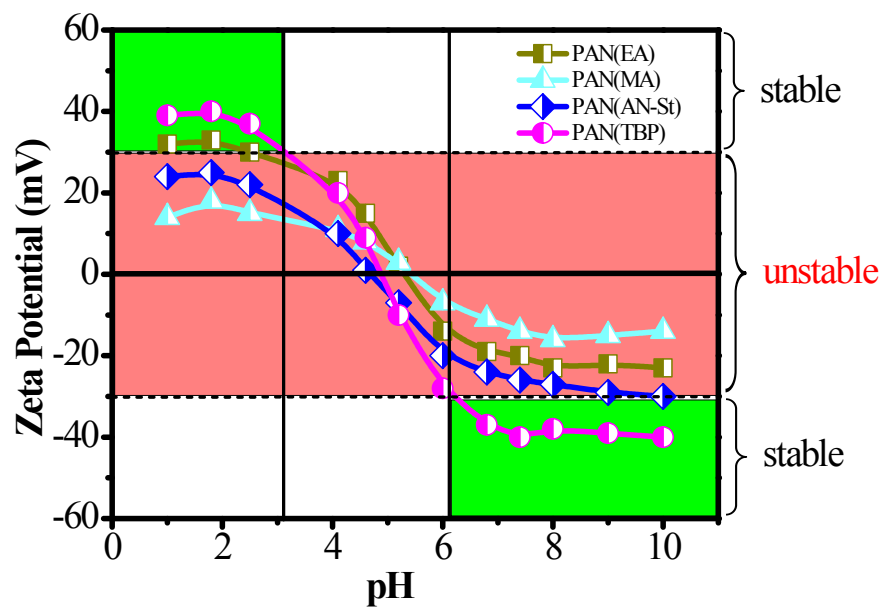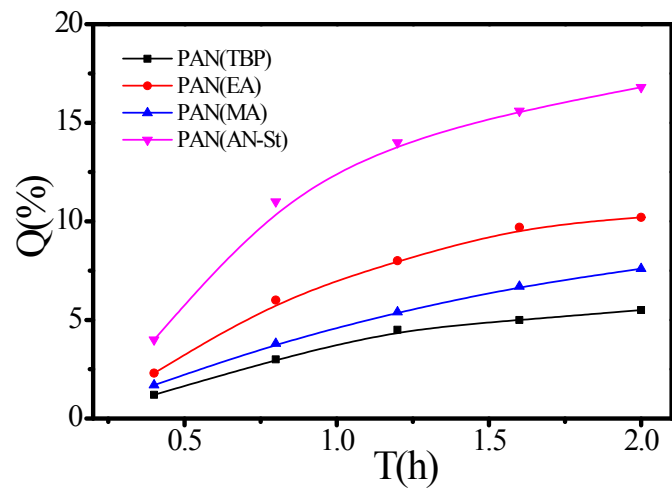4 concentrations(wt%): (a) 0.25wt% (b) 1.0wt% (c) 2.0wt%

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%T

4000 3000 2000 1000

Wavenumbers(cm^{-1})

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3   Figure S4 Infrared spectra of PAN and P (AN-St)

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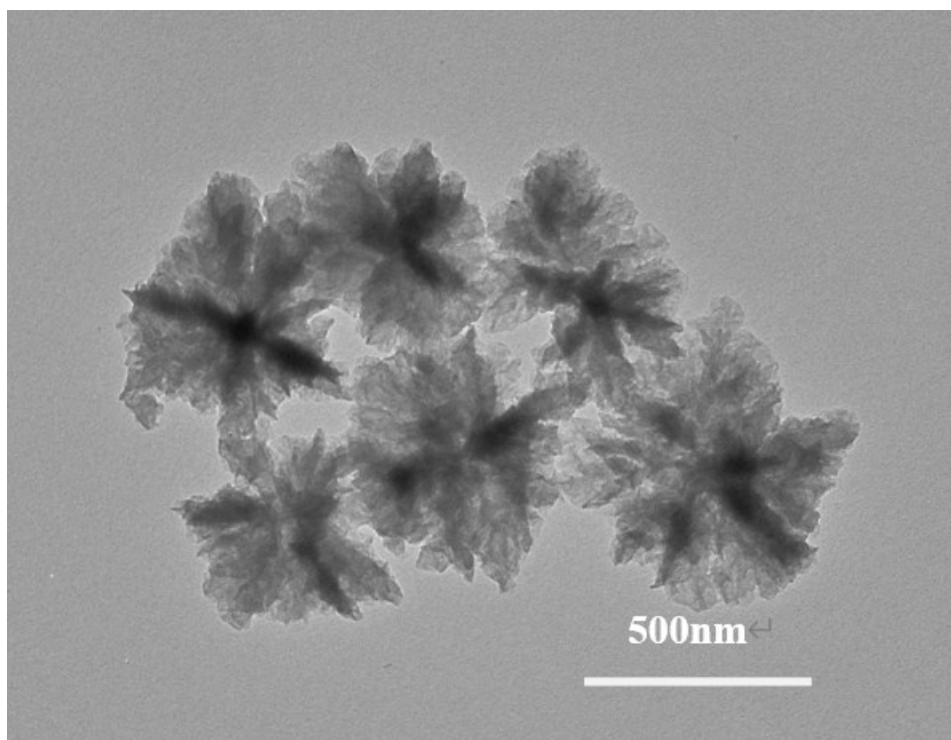3   Figure S5 Effect of pH on zeta potential of drug loading PAN nanoparticles.

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2 Figure S6 The concentration of BSA broken by proteases in mimicking stomach

3 acidic fluids.

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Figure S7 SEM image of the PAN(TBP) after release of BSA.