Supporting Information

Removal of ciprofloxacin from Aqueous Solution on Long TiO_2 Nanotubes with High Specific Surface Area

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Data analysis

Isotherm model

Langmuir model

The form of the Langmuir isotherm can be represented by the following equation:

$$q_e = q_m \frac{K_L C}{1 + K_L C} \qquad (1)$$

where q_e is the amount of dye adsorbed per gram of adsorbent (mg/g), C denotes the equilibrium concentration of dye in solution (mg/L); K_L represents the Langmuir constant (L/mg) that relates to the affinity of binding sites and q_m is a theoretical limit of adsorption capacity when the monolayer surface is fully covered with dye molecules to assist in the comparison of adsorption performance (mg/g). Furthermore, the effect of the isotherm shape was studied to understantwhether an adsorption system is favorable or not. Another important parameter, R_L, called the separation factor or equilibrium parameter, which can be used to determine the feasibility of adsorption in a given concentration range over adsorbent, was also evaluated from the relation[24]:

$$R_L = \frac{1}{1 + K_L C_0} \qquad (2)$$

where K_L is the Langmuir adsorption constant (l/mg) and C_0 is the initial dye concentration (20mg/l). Ho and McKay[25] established that (1) $0<R_L<1$ for favorable adsorption; (2) $R_L>1$ for unfavorable adsorption; (3) $R_L=1$ for linear adsorption; and (4) $R_L=0$ for irreversible adsorption.

Freundlich model

The Freundlich isotherm model has the following form:

$$q_e = K_F C^{1/n} \qquad (3)$$

where q_e is the amount of dye adsorbed per gram of adsorbent (mg/g); C is the equilibrium dye concentration in solution (mg/L); K_F and n are the Freundlich constants, which represent the adsorption capacity and the adsorption strength, respectively. The magnitude of *1/n* quantifies the favorability of adsorption and the degree of heterogeneity of the adsorbent surface.

Dubinin-Radushkevich (D-R) model

The D-R isotherm model has the following form:

$$\ln q_e = \ln q_m - B\varepsilon^2 \qquad (4)$$

B, a constant related to the mean free energy of adsorption (mol^2/kJ^2); q_m, the theoretical saturation capacity; and ε, the Polanyi potential, which is equal to

$$\varepsilon = RT \ln(1 + \frac{1}{C}) \qquad (5)$$

where R ($J \cdot mol^{-1} \cdot K^{-1}$) is the gas constant and T (K) is the absolute temperature. For D-R isotherm model, from B values the mean energy of adsorption. E can be calculated using the relation[26]

$$E = \frac{1}{\sqrt{-2B}} \qquad (6)$$

Based on equations (5), (6) and (7), the isotherm constants, E and determination coefficients were calculated. The mean energy of adsorption (E) is the free energy change when one mole of the ion is transferred from infinity in the solution to the surface of the solid.

Kinetic model

Pseudo-first and pseudo-second model

The linear form of pseudo first-order rate equation is

$$\ln(q_e - q_t) = \ln q_e - \frac{K_1}{2.303} t \qquad (7)$$

where q_e and q_t are the amounts of MO adsorbed (mg/g) at equilibrium and time t (min), respectively; K_1 is the rate constant of the pseudo first-order kinetic model (min^{-1})[25].

A linear form of pseudo second-order kinetic model is express by eq. (8)

$$\frac{t}{q} = \frac{1}{k_2 q_e^{\,2}} + \frac{t}{q_e} \qquad (8)$$

where k_2 is the rate constant($g \cdot mg^{-1} \cdot min^{-1}$) of pseudo second-order kinetic model for adsorption[25].

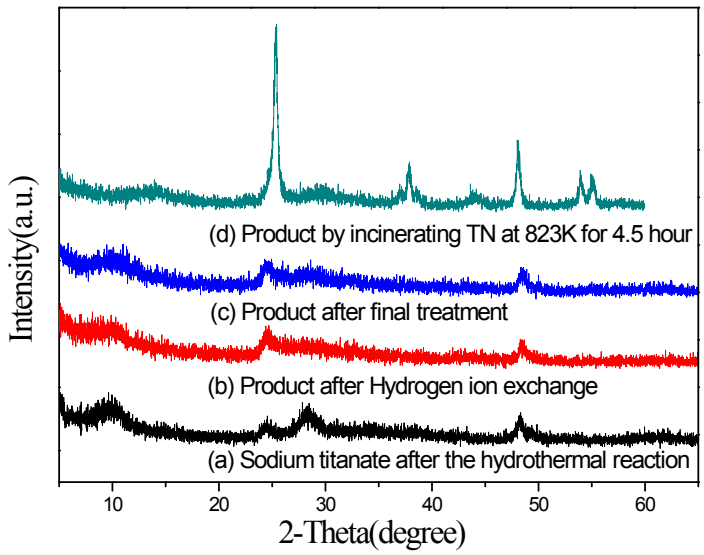

Fig. S1 The XRD pattern of (a) sodium titanate after the hydrothermal reaction, (b) products after hydrogen ion exchange, (c) products after final treatment, (d) products after incinerating TN at 823K for 4.5 h

Table S1 The reported length of TiO_2 nanotubes

Reference	This paper	1	2	3
Length of TiO_2 nanotubes(μm)	1-1.1	4.5	~0.5	0.15