Supplementary Materials

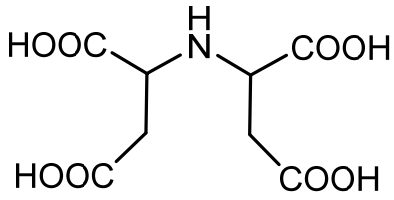

Fig. S1. Structure of IDS

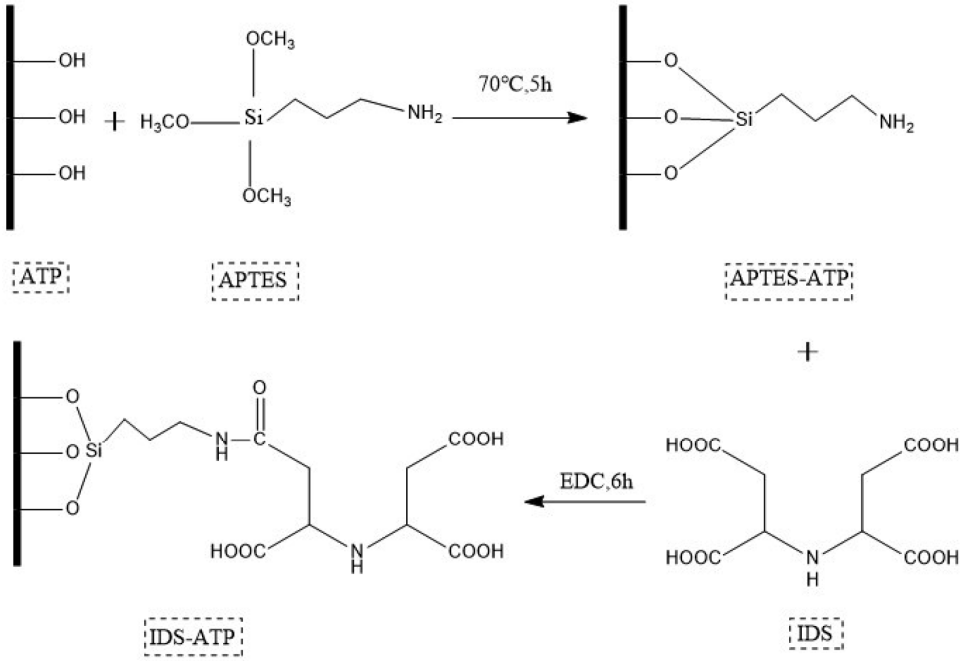

Fig. S2. The preparation process of IDS-ATP

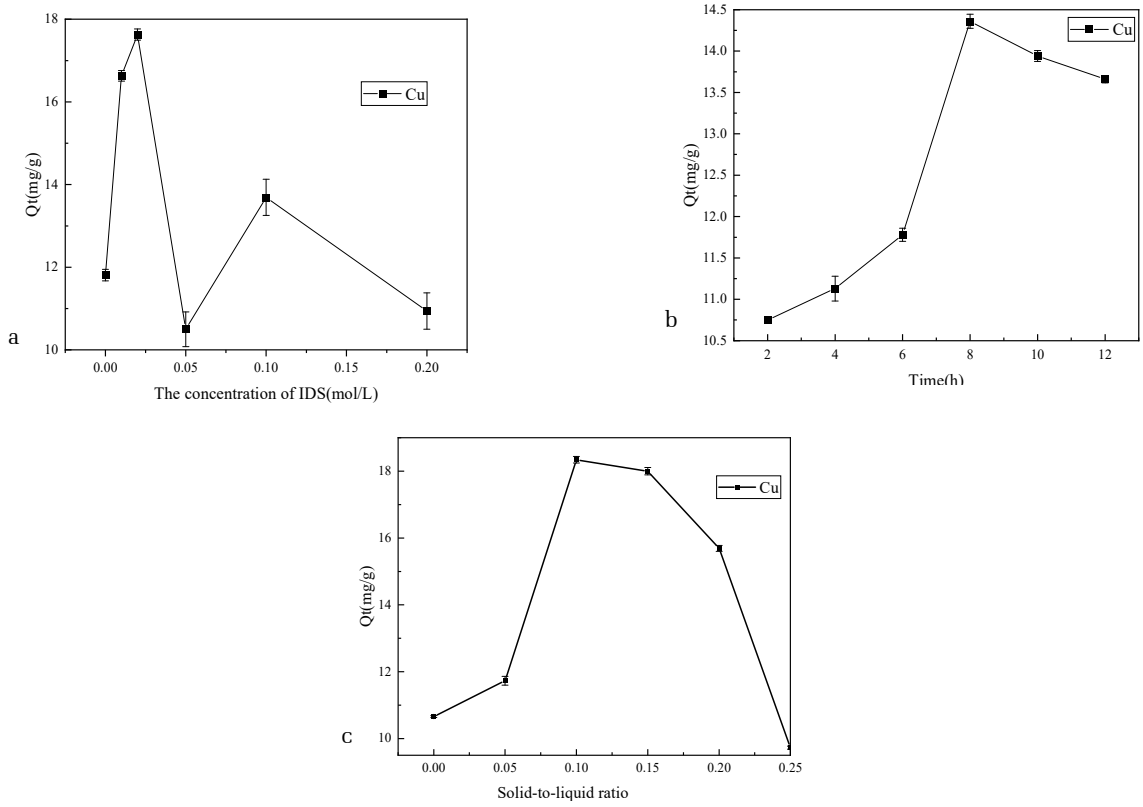

Fig. S3. Comparative experiments to select the modification condition (a) the concentration of IDS; (b) the time of modification; (c) the solid-to liquid ratio of ATP and IDS

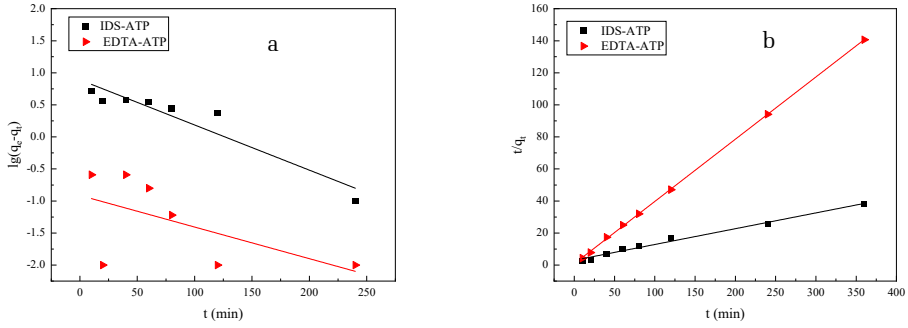

Fig. S4. Quasi-first-order (a) and quasi-second-order (b) dynamic fitting of Cu(Ⅱ) adsorption change

Table S1. Adsorption kinetic parameters of Cu (Ⅱ) on functional Attapulgite

HM	Material	q_e (mg/g)	Quasi-first-order			quasi-second-order		
			k_1 (/min)	q_{eal} (mg/g)	R^2	k_2 (g/mg/min)	q_{eal} (mg/g)	R^2
Cu(Ⅱ)	IDS-ATP	9.45	0.0071	7.78	0.8950	0.0032	10.15	0.9868
	EDTA-ATP	2.56	0.0049	0.12	0.3357	0.1646	2.58	0.9998

Note: qeal is the maximum theoretical adsorption calculated by the correspondin kinetic equation

Table S2. Description of the kinetic models

Kinetic models	Equations	Parameters description
Quasi-first-order	$\lg(q_e - q_t) = \lg q_e - k_1 t/2.303$	q_e is the equilibrium adsorption (mg/g); q_t is the adsorption at time t (mg/g); t is the adsorption time; k_1 is the quasi-first-order rate constant (/min); k_2 is the quasi-second-order rate parameter (g/mg/min).
Quasi-second-orde	$t/q_t = 1/(k_2 q_e^2) + t/q_e$	

Table S3. Description of the equilibrium isotherm equations

Type	EquationsType	Parameters description
Langmuir	$\frac{C_e}{Q_e} = \frac{1}{Q_m K_L} + \frac{C_e}{Q_m}$	Q_e (mg/g) is the adsorbed amount, C_e (mg/L) is the equilibrium concentration, Q_m (mg/g) is the maximum adsorption amount and K_L (L/mg) is the affinity coefficient
Freundlich	$LnQ_e = LnK_F + \frac{LnC_e}{n}$	K_F (mg/g) is Freundlich affinity coefficient and n is the characteristic constant associated with the temperature

Among them, the equilibrium constant RL of the Langmuir adsorption isotherm model reflects the difficulty of the reaction, and the expression is:

$$R_L = 1/(1 + K_L \cdot C_e)$$

Where C_e(mg/L) is the equilibrium concentration. When R_L=0, it is non-reversal adsorption; when 0< R_L <1, it means adsorption is easy to proceed; when R_L =1, it is a linear value; when R_L >1, it means adsorption is difficult to proceed.

Table S4. Adsorption isotherm parameters

Metal	Material	Langmuir				Freundlich		
		Q_m(mg/g)	K_L	R^2	R_L	n	K_F	R^2
Cu(II)	IDS-ATP	18.2831	0.0834	0.9802	0.04283	5.2706	6.3431	0.9102
	EDTA-ATP	3.2951	0.2849	0.7655	0.01179	10.4254	1.9872	0.9523

NOTE: b>0, 0< R_L <1.

Table S5. Adsorption isotherm parameters

Metal	Material	Langmuir	Freundlich
Cu(II)	IDS-ATP	$\frac{C_e}{Q_e} = 0.6558 + 0.0547C_e$	$LnQ_e = 1.8474 + 0.1897LnC_e$
	EDTA-ATP	$\frac{C_e}{Q_e} = 1.0652 + 0.3035C_e$	$LnQ_e = 0.6867 + 0.0959LnC_e$