Electronic Supplementary Information (ESI)

Glutamic acid-modified cellulose fibrous composite for adsorption of heavy metal ions from single and binary solutions

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1. Determination of COOH content

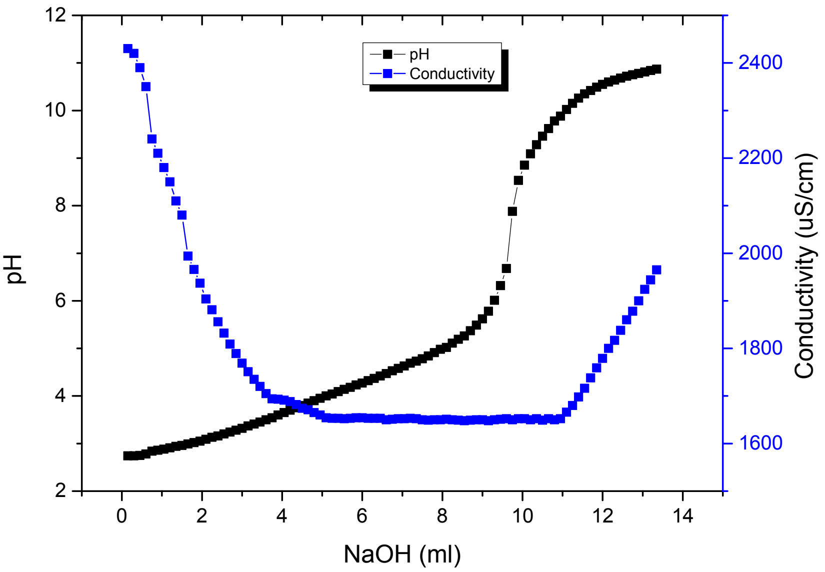

Figure S1. Electric conductivity titration ([NaOH]= 0.061mol · L^{-1}, $V_{NaOH,equlibrium}$=5.95 mL, m_{GMC}= 0.3 g). The COOH was calculated to be 1.2 mmol · g^{-1}.

2. FTIR spectra

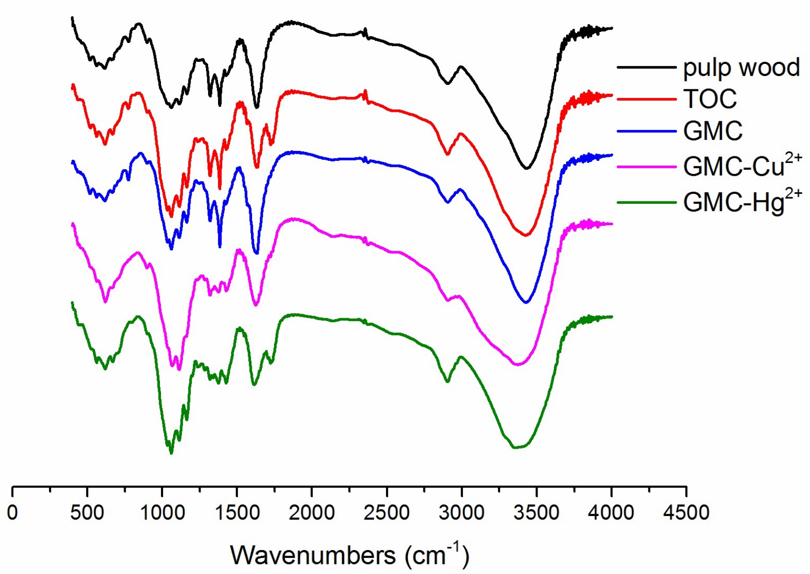

Figure S2. FI-IR spectra of cellulose, TEMPO oxidised cellulose (1.2 mmol·g^{-1} COOH), Glutamic modified cellulose and Cu(II)-loaded GMC, Hg(II)-loaded GMC.

3. **Adsorption capacity comparison of unmodified cellulose and GMC**

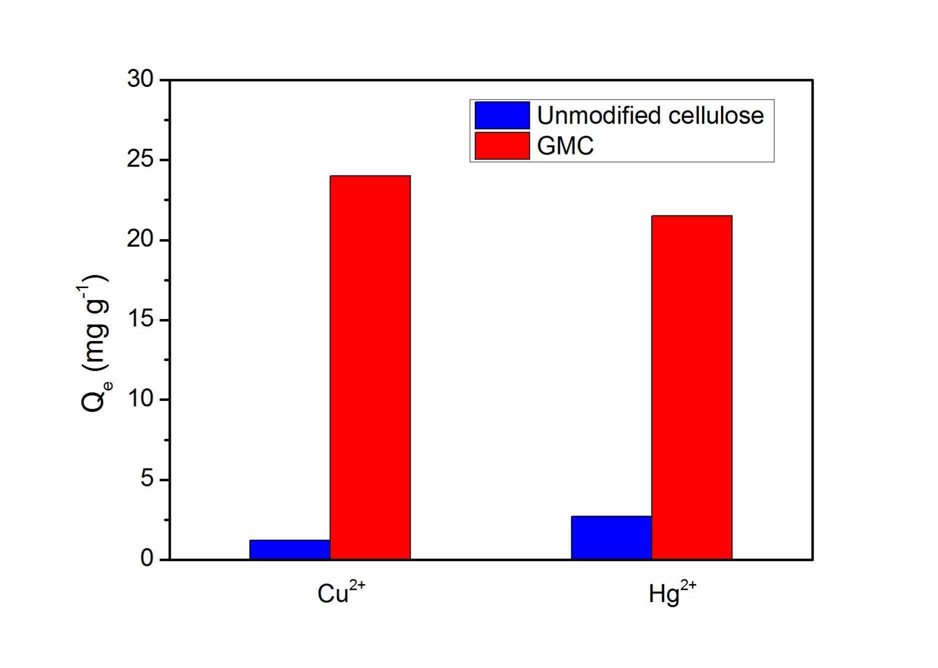

Figure S3. The adsorption capacity comparison of unmodified cellulose and GMC. Conditions: pH = 5, both unmodified cellulose and GMC dosage were 2.0 g L^{-1}, and t = 30 mins, [Cu^{2+}] = [Hg^{2+}] = 50 ppm.

4. The pseudo-first-order kinetic model, the pseudo-second-order kinetic model

and intraparticle diffusion model curves fitted for Cu^{2+} and Hg^{2+} adsorption onto GMC

4.1 Pseudo-first-order kinetic model

$$\ln(Q_e - Q) = \ln Q_e - kt \quad \textbf{(1)}$$

where Q_e and Q are the amount of solute adsorbed per unit adsorbent at equilibrium and time t, respectively. k is the rate constant for the pseudo-first-order kinetics.

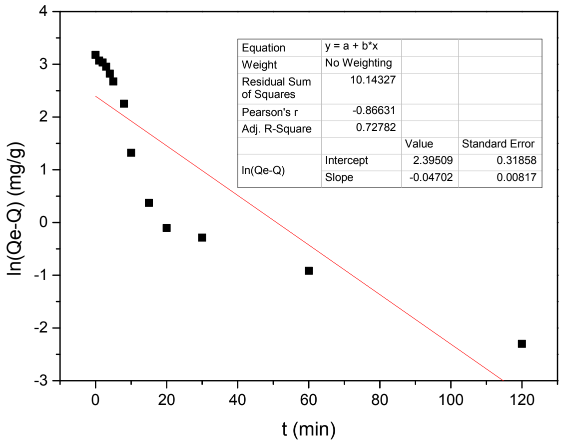

Figure S4. Pseudo-first order kinetic model for Cu^{2+} adsorption

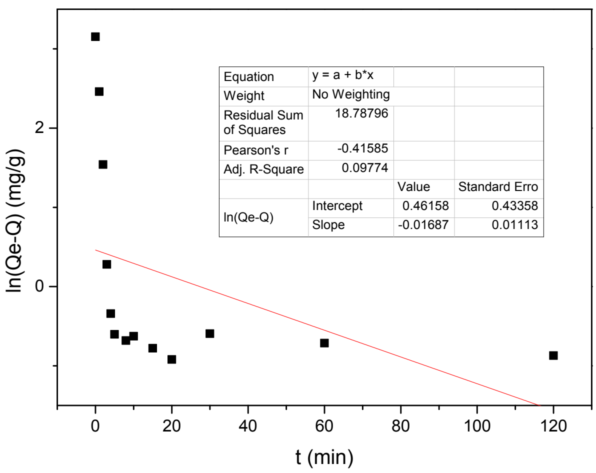

Figure S5. Pseudo-first order kinetic model for Hg^{2+} adsorption

4.2 pseudo-second-order kinetic model

$$\frac{t}{Q} = \frac{1}{kQ_e^2} + \frac{t}{Q_e} \quad \textbf{(2)}$$

where Q_e and Q are the amount of solute adsorbed per unit adsorbent at equilibrium and time t, respectively. k is the rate constant for the pseudo-second-order kinetics.

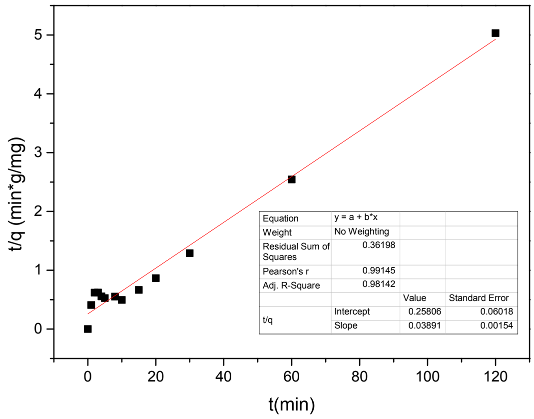

Figure S6. Pseudo-second order kinetic model for Cu^{2+} adsorption

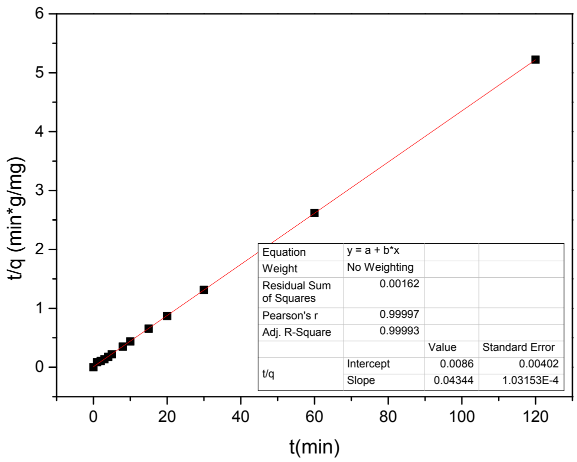

Figure S7. Pseudo-second order kinetic model for Hg^{2+} adsorption

4.3 Intraparticle diffusion model

The rate constant of intraparticle diffusion (kdi) at the stage i was given by the equation:

$$Q_t = k_{di} t^{1/2} + C_i \qquad (3)$$

Where Q_t is the amount of Cu^{2+}/Hg^{2+} absorbed on bioadsorbent, $t^{1/2}$ is the square root of adsorption time, and C_i is the intercept at different stage.

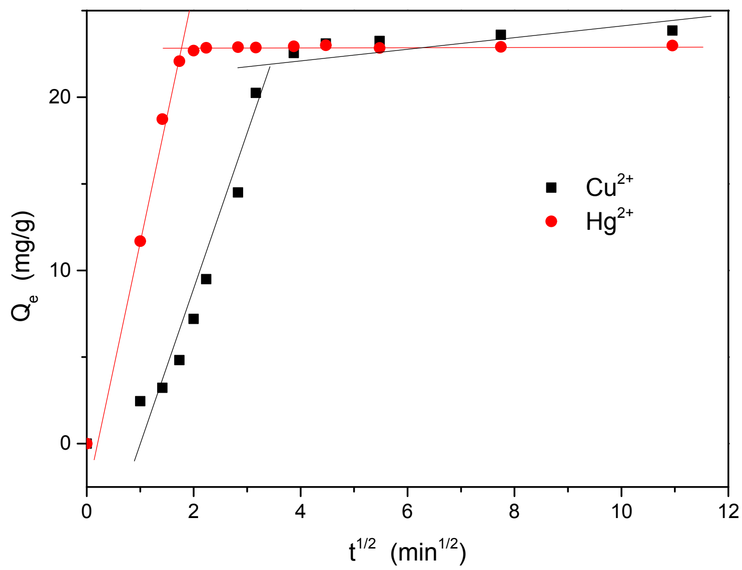

Fig. S8 Intraparticle diffusion model for adsorption of Cu^{2+} and Hg^{2+} on GMC at pH=5 and 25℃

Table S1 Intraparticle diffusion model constants and correlation coefficients for adsorption of Cu^{2+} and Hg^{2+} on GMC at pH=5 and 25 ℃

C_0/Metal mg・L^{-1}	k_{d1} mg・(g・$t^{1/2}$)$^{-1}$	C_1	$(R_1)^2$	k_{d2} mg·(g・$t^{1/2}$)$^{-1}$	C_2	$(R_2)^2$
50- Cu^{2+}	6.24	-3.46	0.84	0.16	22.25	0.77
50- Hg^{2+}	12.93	-0.27	0.99	0.02	22.8	0.21

5. Langmuir isotherm model and Freundlich isotherm model curves of Cu^{2+} and

Hg^{2+} adsorption onto GMC

5.1 Langmuir isotherm model

$$\frac{c_e}{Q_e} = \frac{1}{Q_m \times b} + \frac{c_e}{Q_m} \qquad (4)$$

where Q_m and b are the Langmuir constants related to maximum adsorption capacity and equilibrium constant or energy of adsorption, respectively. Q_e is the observed adsorption capacity (mg/g) and C_e is the equilibrium concentration (mg/L).

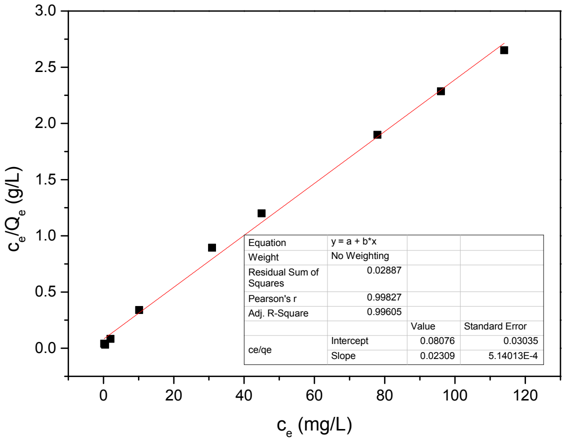

Figure S9. Langmuir adsorption isotherm of GMC for Cu^{2+} adsorption

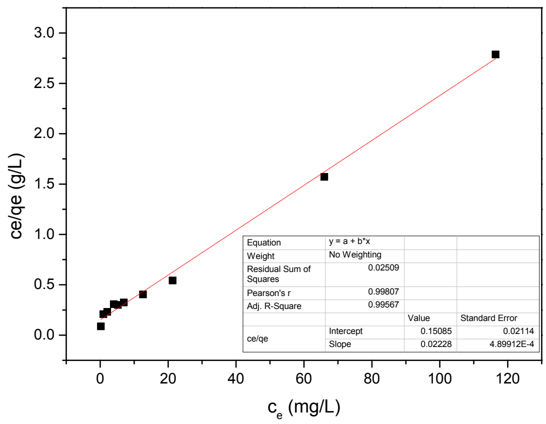

Figure S10. Langmuir adsorption isotherm of GMC for Hg^{2+} adsorption

5.2 Freundlich isotherm model

$$\ln Q_e = \ln K_f + \frac{1}{n} \ln c_e \quad (5)$$

where n is adsorption strength, K_f is adsorption capacity, Q_e is the observed adsorption capacity (mg/g) and C_e is the equilibrium concentration (mg/L).

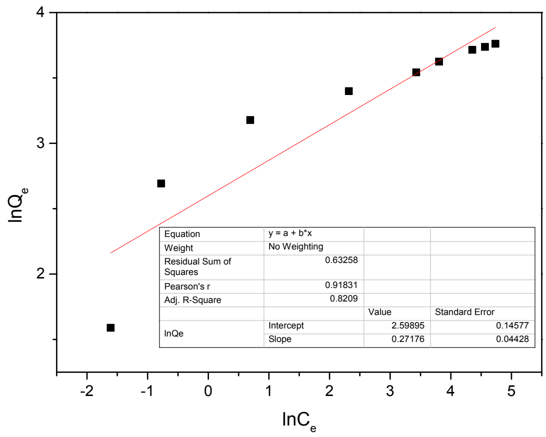

Figure S11. Freundlich adsorption isotherm of GMC for Cu^{2+} adsorption

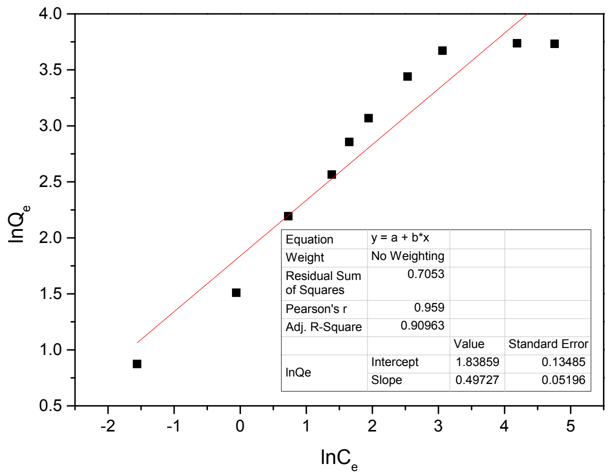

Figure S12. Freundlich adsorption isotherm of GMC for Hg^{2+} adsorption