Supporting information

High-performance polymer hydrogel derived from konjac flying powder for removal of heavy metals

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Characterization

The Fourier-transform infrared spectroscopy (FTIR) measurements were record on a Nicolet 6700 Spectrometer (Thermo Scientific, USA) in the range from 4000 to 400 cm^{-1} with a resolution of 4 cm^{-1} on thin KBr disc. X-ray diffraction (XRD) measurements were carried out on a Bruker D8 Advance diffractometer (Bruker, Germany) in the range of 5 to 30° using Cu Kα radiation (40kV, 40 mA, λ=1.5418 Å) at a voltage and current 40 kV and 30 mA, respectively. The surface composition of the samples before and after adsorption were studied using X-ray photoelectron spectroscopy (XPS, Thermo Fisher MultiLab 2000) with a monochromatic Mg Kα X-ray source operated at 20kV under vacuum at 2×10^{-6}Pa. The reference of all binding energies was calibrated to the C1s peak at 284.8 eV. Thermogravimetric analysis (TGA) was performed on a thermogravimetric analyzer (TG209 F3, NETZSCH, Germany) from 30 to 700°C range with a heating rate of 10°C/min under nitrogen atmosphere. The morphology of samples was observed by scanning electron microscope on a SU8010 (SEM, Hitachi, Japan) with an accelerating voltage of 2kV. The elemental mapping and compositional analysis were examined during FESEM analysis on X-ray spectrometer (EDX, Thermo Scientific Ultra Dry SDD). Atomic absorption spectroscopy (Perkin Elemer, AAS, AA700 USA) was applied to detect the heavy metal ion concentrations with flame system in all batch adsorption experiments. The zeta potentials of KFPH dispersions were measured via a Zetaprobe analyzer (Colloidal Dynamics). Chemical oxygen demand (COD) was used to check organic leaching from the KFP and KFPH. 10mg adsorbent (KFP or KFPH) was added into 100ml ultrapure water and the mixture was stirred with a magnetic stirrer at 300 rpm for about 12 hours, the supernatant solution was withdrawn after settling for a few minutes. Standard Methods (APHA) were applied for COD, total ammonia (NH_4^+-N), total phosphorus and volatile solid (VS) determination. The COD values of KFP and modified KFPH samples measured by the potassium dichromate method

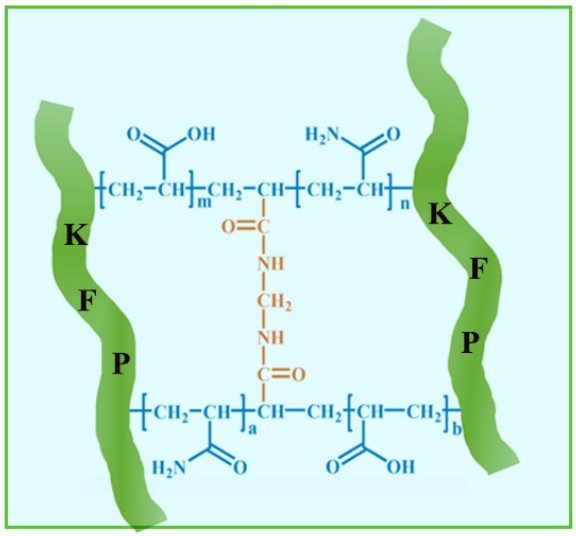

Fig. S1. The cross-link structure of KFPH.

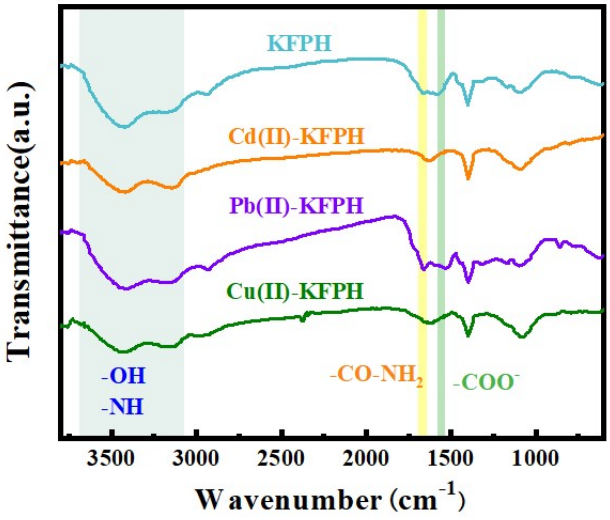

Fig. S2. FTIR analysis of KFPH before and after adsorption.

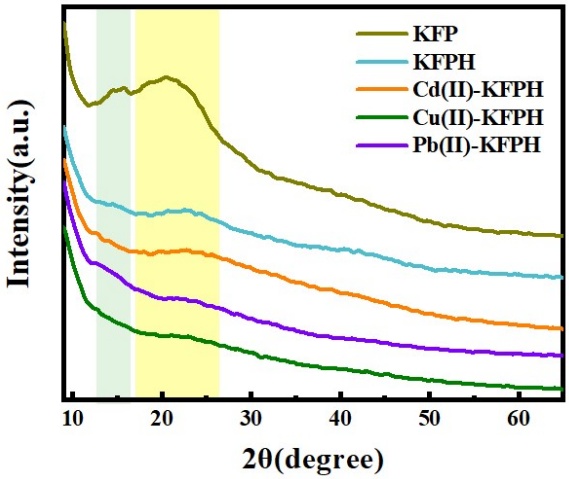

Fig. S3. XRD analysis of KFPH before and after adsorption.

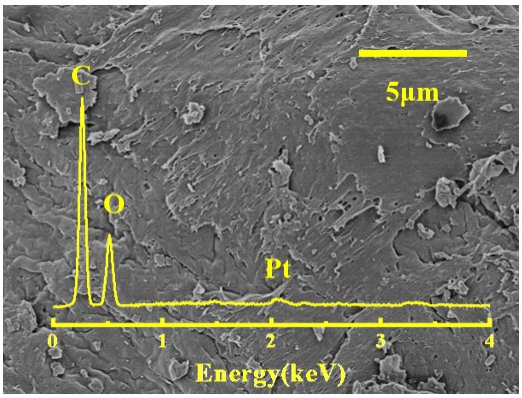

Fig. S4. SEM images and EDX spectrum of KFP.

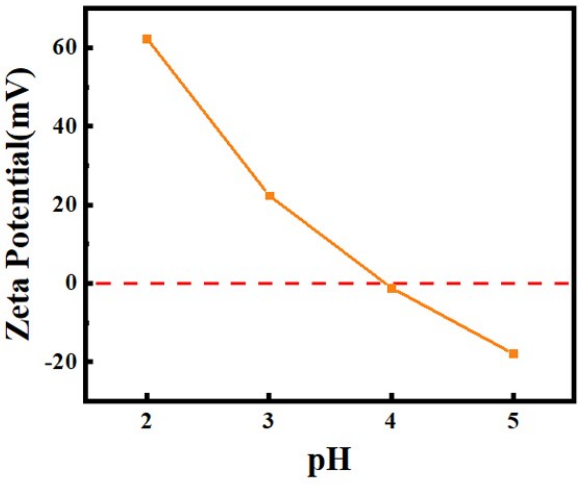

Fig. S5 Effect of pH values on zeta potential of KFPH.

Table S1. Contents of all components but lignocellulose in KFP[26].

Components	Content (wt %)	Components	Content (wt %)
starch	38.76	Mg	0.23
protein	20.70	Fe	0.02
konjac glucomannan	7.20	Zn	0.01
ash	5.60	Cu	0.003
Ca	1.45	Mn	0.006

Table S2. Date and assignments of the binding energies of C1s, O1s and N1s spectra of of KFPH, Cd(II)-KFPH, Pb(II)-KFPH and Cu(II)-KFPH.

Element	Binding Energy (eV)				Assignments
	KFPH	Cd(II)-KFPH	Cd(II)-KFPH	Cd(II)-KFPH	
O1s	531.00	531.19	531.25	531.20	-C-O / C-O-C
	531.82	531.91	531.99	531.96	-C=O
	532.69	532.78	532.75	532.86	$-COO^-$
	536.01	536.11	536.10	536.13	-COOH
C1s	284.40	284.47	284.49	284.49	C-C / C-H
	285.01	285.03	285.09	285.05	C-N / C-O-C
	288.09	288.07	288.02	288.02	$-COO^-$
N1s	399.39	399.59	399.50	399.50	N-H
	400.03	400.20	400.10	400.10	N-C

Table S3. Comparison of KFPH with other previously reported biomass-based adsorbents for heavy metal ion removal.

Langmuir Isotherm	q_{max} (mg/g)			Ref.
	Cd(II)	Pb(II)	Cu(II)	
Rice straw-derived biochar	75	-	-	[36]
NaOH-modified oak waste	771	-	-	[24]
peanut shell adsorbent named (g-PS)	62	-	-	[21]
Functionalized griculturally wasted lotus seedpod (CLSP)	-	111	-	[23]
soybean dregs– poly(acrylic acid) (SESD–PAA)	-	-	75	[35]
KFPH	635	812	855	This work