Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Mussel-inspired hybrid copolymer adhered to chitosan-coated micro-sized carbon fiber aerogels for high-efficient nanoparticles scavenger

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Table S1. Isotherm parameters obtained by linear isotherm model for the adsorption of Au and Ag NPs onto MCFAs@CS@PDA/PEI

Isotherm	Langmuir				Freundlich		
	Q_o (mg g^{-1})	K_L (L mg^{-1})	R^2		K_F ($mg \cdot g^{-1}$) ($L \cdot mg^{-1}$)$^{1/n}$	n	R^2
Langmuir (Ag NPs)	41.84	0.95	0.9991	Ag NPs	987.6	2.137	0.8758
Langmuir (Au NPs)	31.23	1.77	0.9994	Au NPs	890.9	2.833	0.9581

Table S2. Kinetic models parameters for the adsorption of Au and Ag NPs onto MCFAs@CS@PDA/PEI at different initial Au/Ag NPs concentrations

	C_0 ($mol \cdot L^{-1}$)	$q_{e,exp}$ (mg g^{-1})	Pseudo-first-order			Pseudo-second-order		
			k_1 (min^{-1})	$q_{e,calc}$ (mg g^{-1})	R^2	k_2 (g mg^{-1} min^{-1})	$q_{e,calc}$ (mg g^{-1})	R^2
Ag NPs	1.0×10^{-4} M	6.66	0.114	5.61	0.9991	0.024	7.40	0.9999
	2.5×10^{-4} M	13.88	0.068	15.3	0.9989	0.0066	15.47	0.9999
	5.0×10^{-4} M	30.3	0.044	12.81	0.9991	0.0063	31.74	1.0000
	6.5×10^{-4} M	33.2	0.039	21.54	0.9993	0.0030	37.31	1.0000
Au NPs	0.67×10^{-4} M	7.14	0.044	5.81	0.9990	0.0083	8.26	1.0000
	1.36×10^{-4} M	19.6	0.032	15.95	0.9991	0.0051	21.00	0.9999
	2.72×10^{-4} M	27.02	0.032	9.67	0.9992	0.0045	29.41	1.0000
	4.08×10^{-4} M	31.25	0.037	10.80	0.9990	0.0058	33.33	0.9999

Table S3. The cost evaluation among different adsorbents.

Adsorbents	Reproducibility	Absorptive Capacities for Au NPs and Ag NPs (mg g^{-1})	Material Cost for 1.0 Kg ($)
Chitosan-coated cellulose nanofibers [1]	2	17.9 and 13.1	～150
Polyethylenimine-coated carbon spheres [2]	1	102 and 135	～420
PVA/gluten hybrid nanofibers [3]	1	36.5 and 31.8	～630
Polyvinyl alcohol nanofibers [4]	1	79 and 56	～570
Carbonaceous nanofiber membranes [5]	No study	Removal rate ＞90 %	～700
Hybrid PDA/PEI copolymer grafted onto CS-coated micrometer-sized carbon fiber aerogels	2	30.2 and 34.9	～270

[1] N. Mahanta, W.Y. Leong and S. Valiyaveettil, *J. Mater. Chem*., 2012, 22, 1985-1993.

[2] J. Kumar, R. Mallampati, A. Adin and S. Valiyaveettil, *ACS Sustainable Chem. Eng*., 2014, 2, 2675-2682.

[3] B. Dhandayuthapani, R. Mallampati, D. Sriramulu, R.F. Dsouza and S. Valiyaveettil, *ACS Sustainable Chem. Eng*., 2014, 2 (4), 1014-1021.

[4] N. Mahanta and S. Valiyaveettil, *Nanoscale*, 2011, 3, 4625-4631.

[5] H.-W. Liang, L. Wang, P.-Y. Chen, H.-T. Lin, L.-F. Chen, D. He and S.-H. Yu, *Adv. Mater.,* 2010, 22, 4691-4695.

Table S4. Summary of filtration of different nanoparticles solution after passing through a column filled with MCFAs@CS@PDA/PEI

	Citrate capped Au nanoparticles	Citrate capped Ag nanoparticles
Time/min	Efficiency/%	Efficiency/%
15 (first 20 mL)	96.21	98.15
Next 20 mL	74.33	77.96

Table S5. The area ratio of each fitting peaks for N1s in the MCFAs@CS@PDA/PEI sample.

	$N-(C)_3$) (%)	C=N (%)	N-H (%)
N1s	400.8 eV	401.6 eV	402.4 eV
	19.20	49.50	31.30

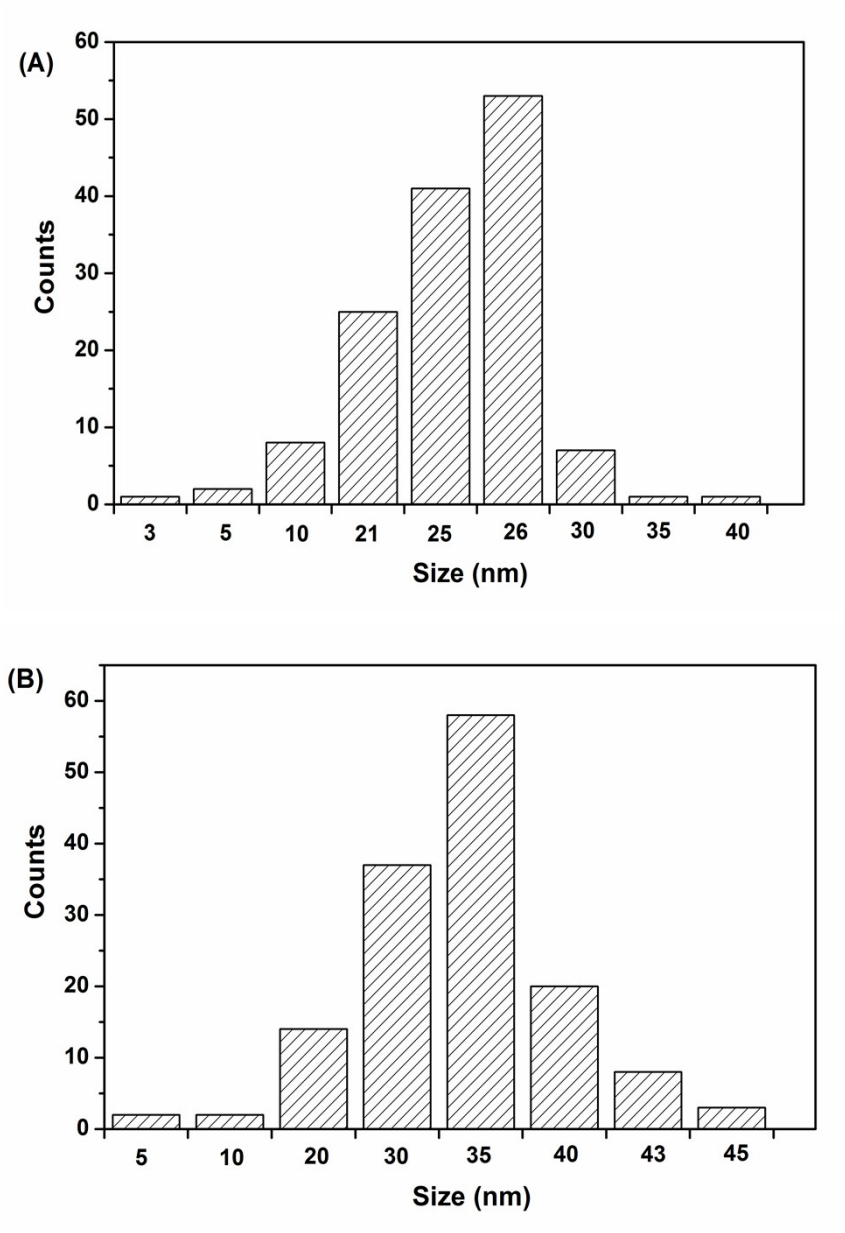


Figure S1. Particle size distribution of Ag NPs (A) and Au NPs (B). Particle size distribution of Ag NPs is 26 nm ± 2 nm and of Au NPs is 35 nm ± 3 nm.

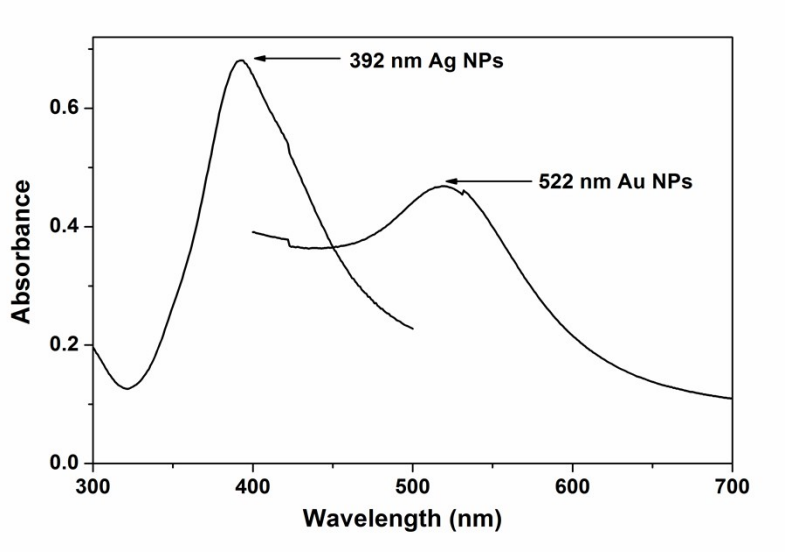


Figure S2. UV-Vis spectra of citrate capped Au and Ag nanoparticles.

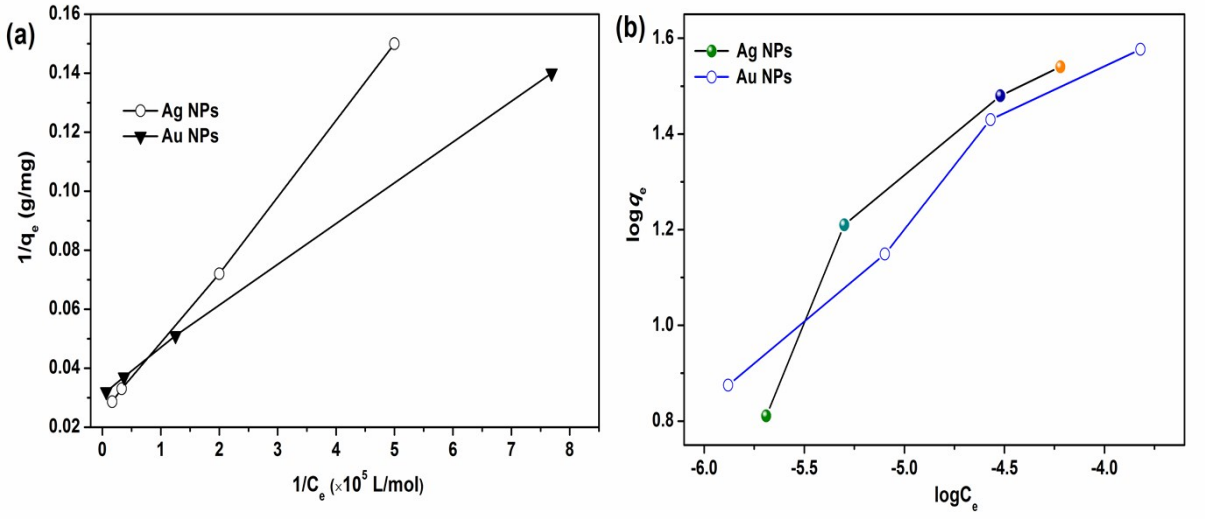


Figure S3. Plots of linear Langmuir (a) and Freundlich isotherm (b) models for the adsorption of Au and Ag nanoparticles onto MCFAs@CS@PDA/PEI at 303 K.

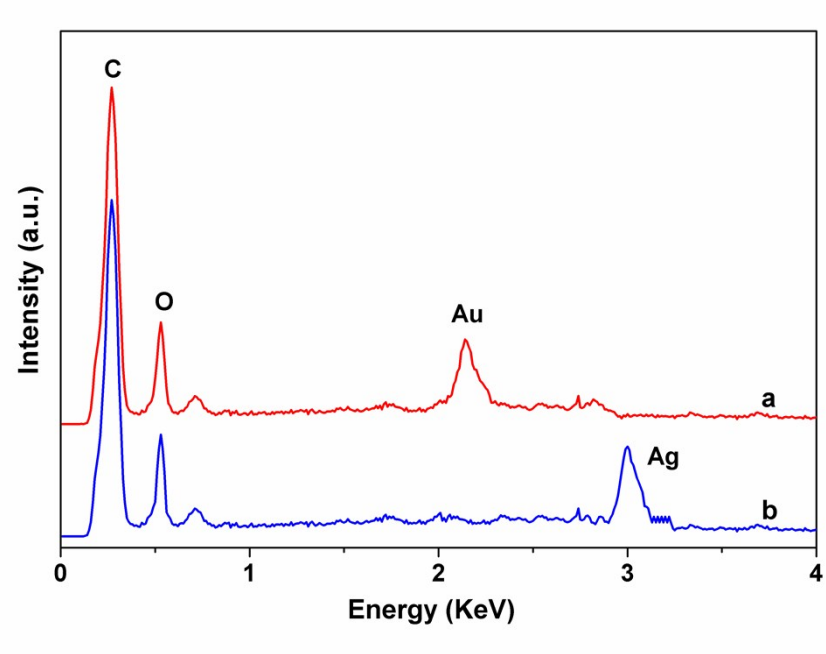


Figure S4. EDS data of MCFAs@CS@PDA/PEI after adsorption of (a) Au NPs and (b) Ag NPs.

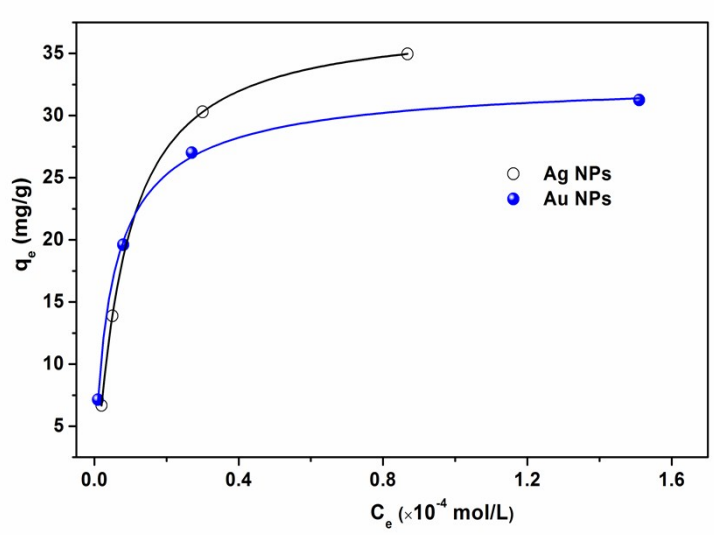


Figure S5. Plot of isothermal adsorption for the adsorption of Au and Ag nanoparticles onto MCFAs@CS@PDA/PEI at 303 K.

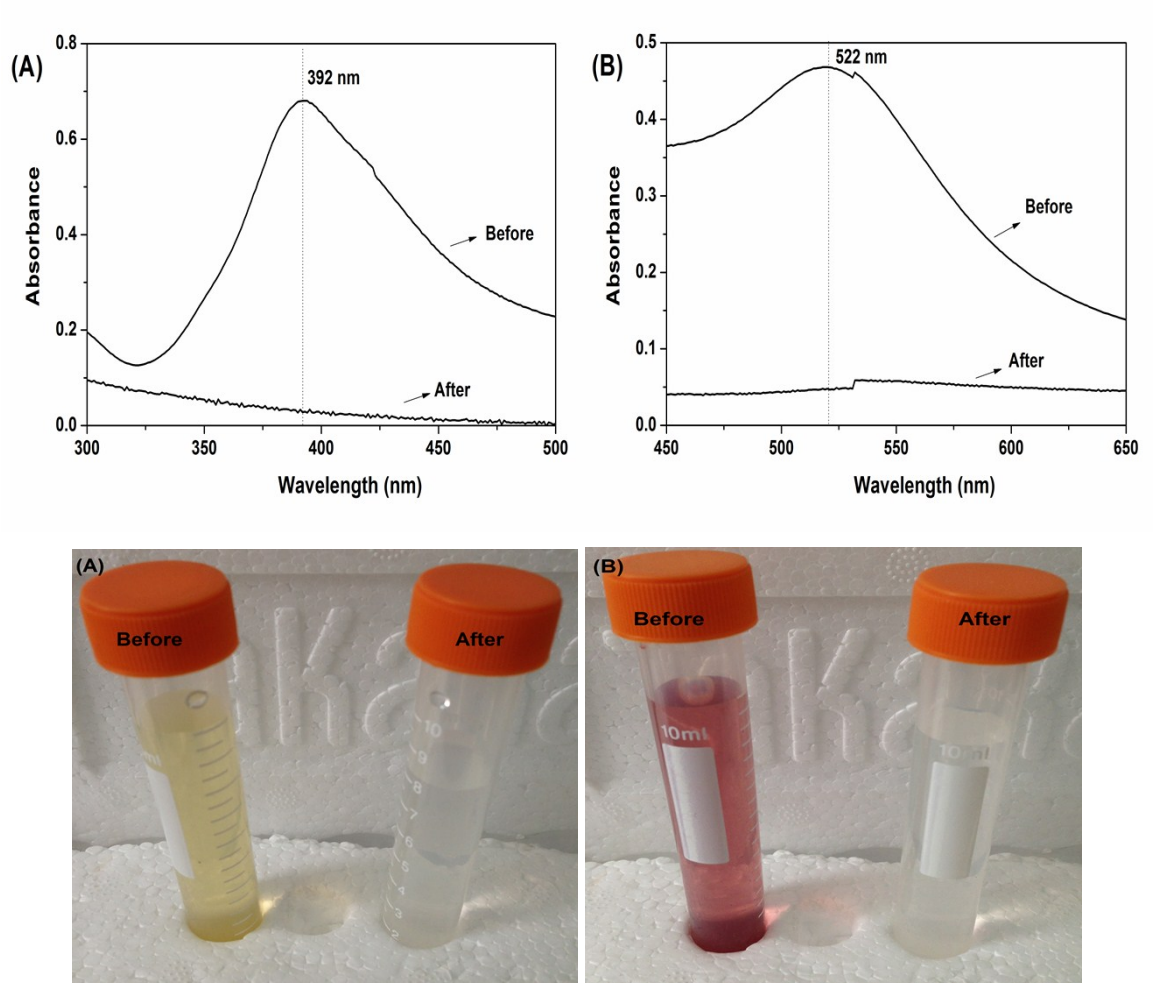


Figure S6. UV-Vis spectra of the Ag NPs (0.8×10^{-4} M) and Au NPs (1.0×10^{-4} M) solutions and purified solutions by using 30 mg MCFAs@CS@PDA/PEI as adsorbent. The photos are corresponding to the initial Ag NPs and Au NPs solutions after ten minutes static adsorption treatment under identical conditions.

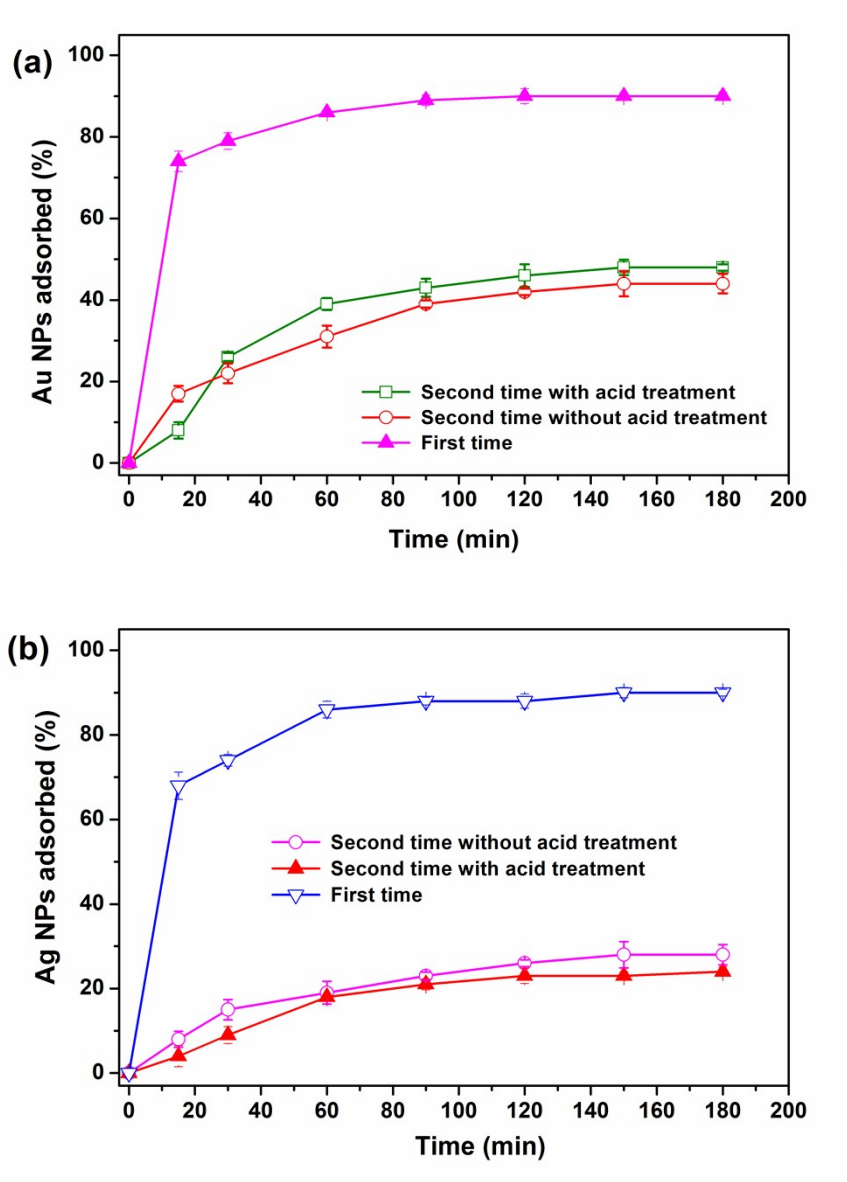
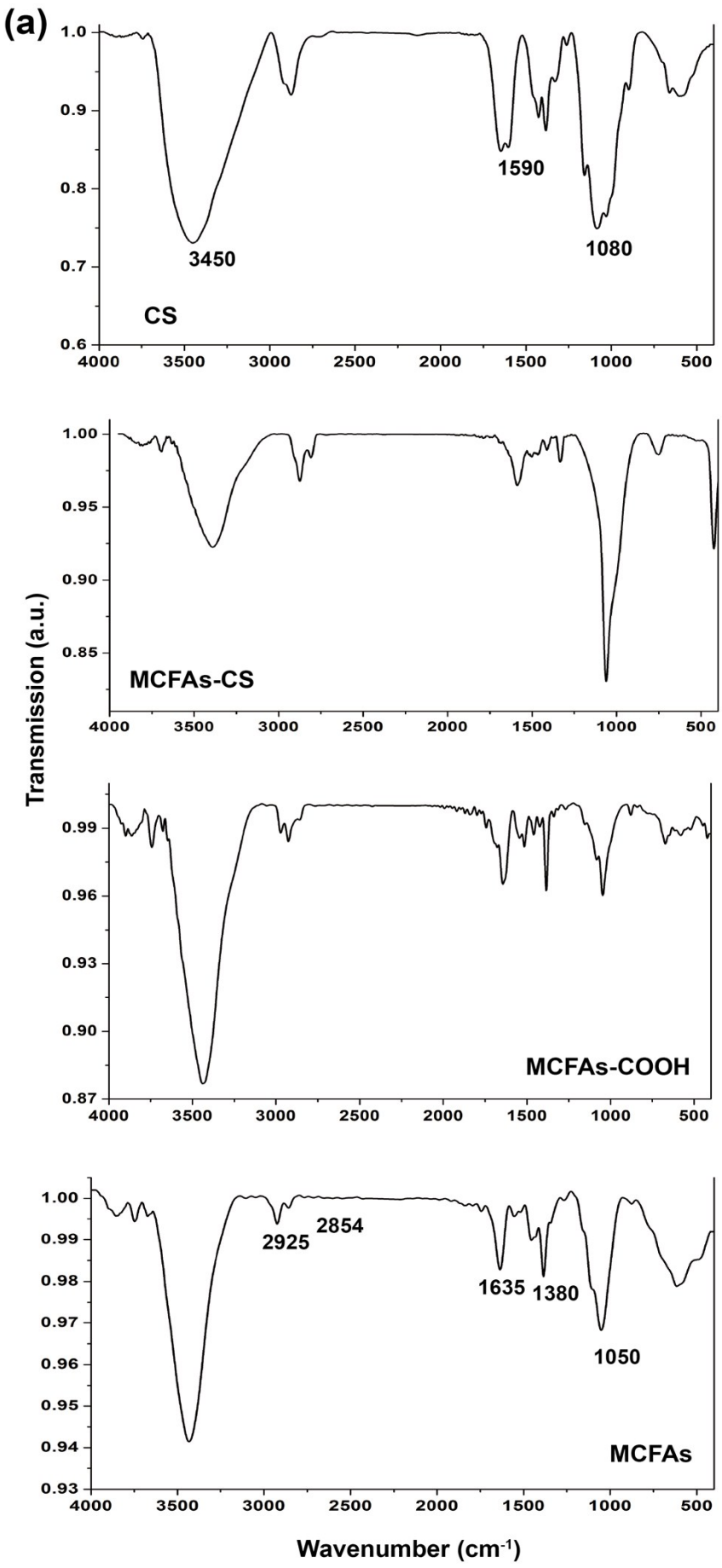


Figure S7. The adsorption efficiencies of MCFAs@CS@PDA/PEI for first time adsorption, second time without and with acid treated fibers using citrate capped Au-nanoparticles (a, 2.72×10^{-4} M) and citrate capped Ag-nanoparticles (b, 6.5×10^{-4} M).


(a)
CS
3450
1590
1080
MCFAs-CS
MCFAs-COOH
MCFAs
2925
2854
1635
1380
1050
Transmission (a.u.)
Wavenumber (cm-1)

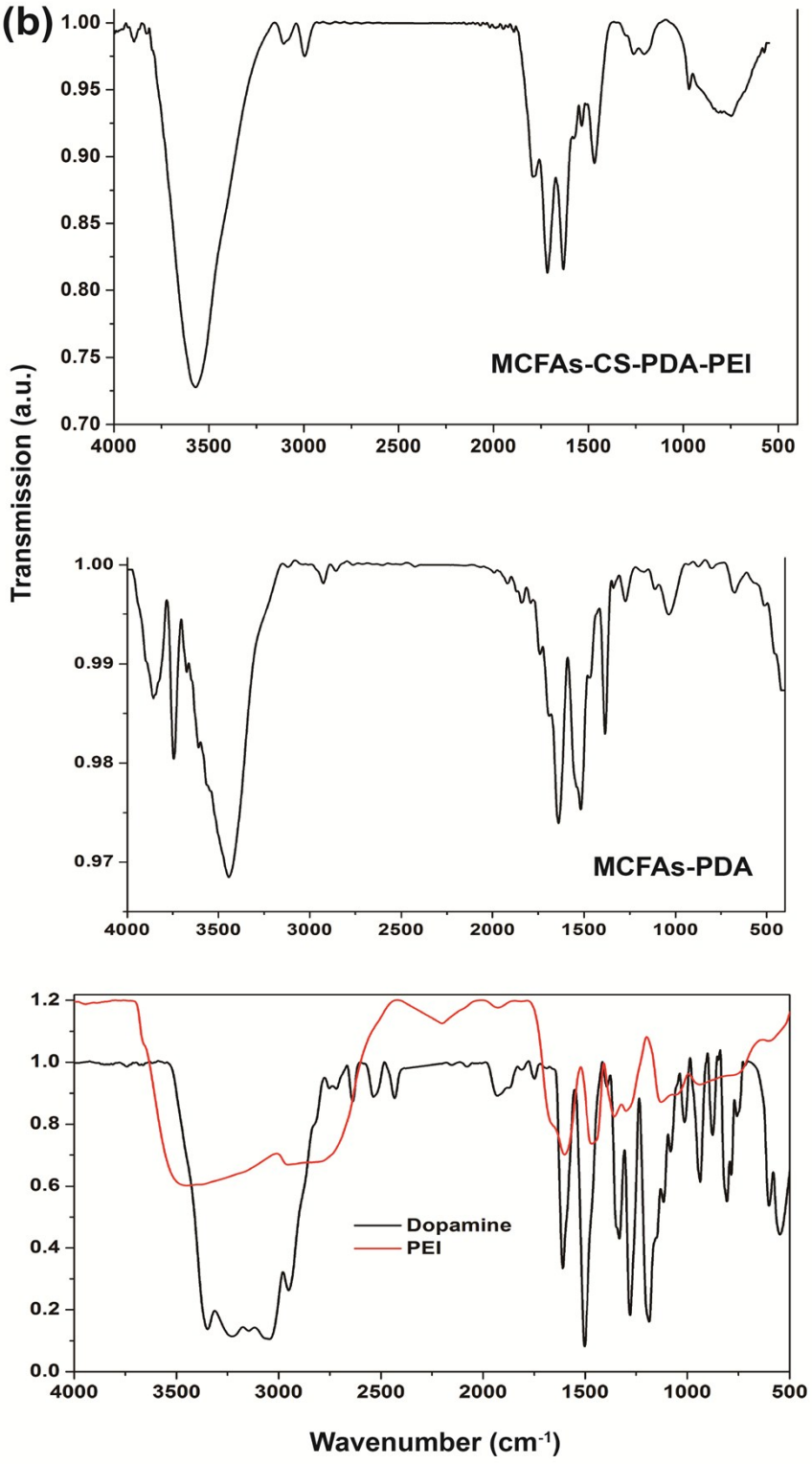


Figure S8. FTIR/ATR spectra of the chitosan (CS), MCFAs-CS, MCFAs-COOH and MCFAs (a); MCFAs-CS-PDA-PEI, MCFAs-PDA, dopamine and polyethyleneimine (b).

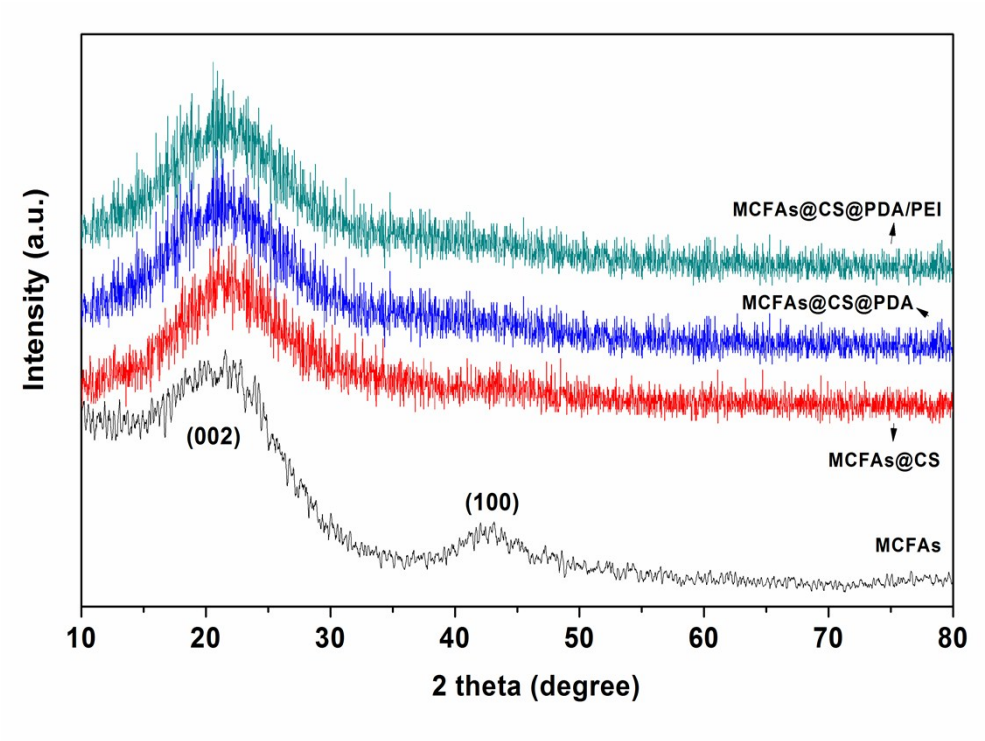


Figure S9. XRD patterns of MCFAs, MCFAs@CS, MCFAs@CS@PDA and MCFAs@CS@PDA/PEI composites (λ = 1.54 Å)