Supporting Information

Branched polyethylenimine grafted electrospun polyacrylonitrile fiber membrane: A novel and effective adsorbent for Cr(VI) remediation in wastewater

Rui Zhao,[a] Xiang Li,*[a] Bolun Sun,[a] Yanzi Li,[a] Yumei Li,[a] Rui Yang[b] and Ce Wang*[a]

[a]Alan G. MacDiarmid Institute, Jilin University, Changchun 130012, PR China.

[b]Changchun Monitoring Station，National UrbanWater-supply and Water Quality Monitoring Net，Changchun 130041，PR China.

*Corresponding authors：

Tel.: +86-431-85168292; Fax: +86-431-85168292.

Email address: xiangli@jlu.edu.cn (X. Li), cwang@jlu.edu.cn (C. Wang).

Preparation of electrospun b-PEI/PVA composite fibers (bPEI/PVA) and b-PEI modified electrospun PAN fiber by hydrothermal route (bPEI-PAN(ht))

bPEI/PVA composite nanofibers were fabricated by electrospinning a 8 wt% bPEI/PVA (w/w = 0.32:1) mixture aqueous solution. The as-prepared electrospun fibers were placed inside a desiccator containing chemical cross-linking agent glutalraldehyde (GA, 50%) at 20 °C for 18 h to conduct the cross-linking. The cross-linked fibers were then dried in vacuum oven at 60 °C overnight.

For bPEI-PAN(ht), 40 mL b-PEI aqueous solution (20 mg/mL) and 60 mg electrospun PAN fibers were transferred into the Teflon-lined stainless steel autoclave (50.0 mL) and heated to 160 °C for 24 h. After cooling down to room temperature, the as-prepared fiber membrane was washed several times with distilled water and ethanol, and then dried in vacuum oven at 60 °C overnight.

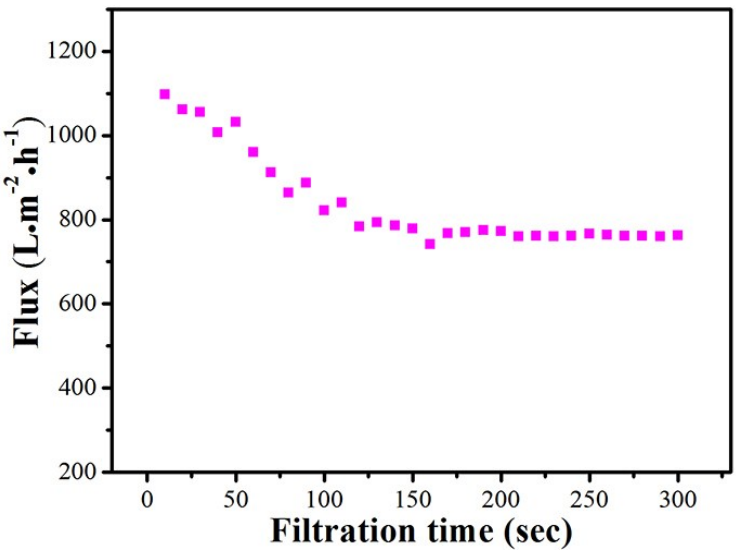

Fig. S1 The water flux for bPEI-EPAN with the thickness of 150 μm.

The membrane filtration system is equilibrated with deionized water prior to the experiment and the Fig. S1 shows this process using the 150 μm bPEI-EPAN membrane as the representative.

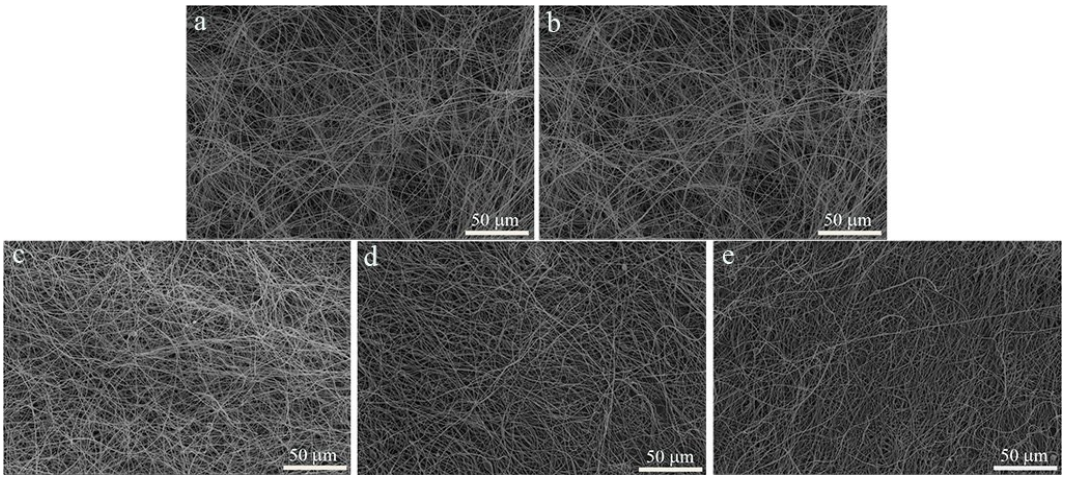

Fig. S2 SEM images of (a) EPANF, (b) bPEI-EPAN-2, (c) bPEI-EPAN-4, (d) bPEI-EPAN-8, and (e) bPEI-EPAN-12 at low magnification.

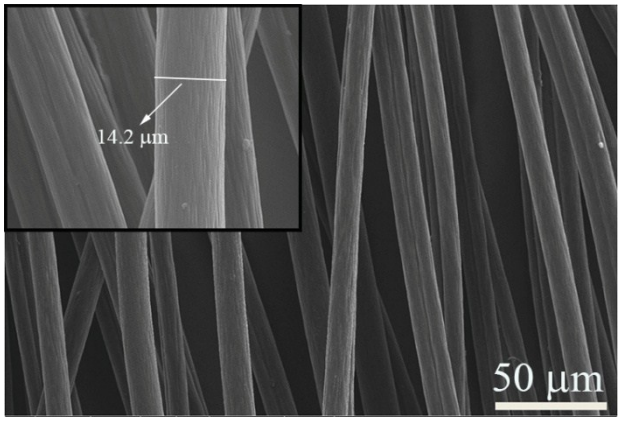

Fig. S3 SEM images of b-PEI grafted PAN synthetic fibers.

As shown in Fig. S3, the diameter of b-PEI grafted PAN synthetic fibers is more than ten micrometers, which is much higher than b-PEI grafted electrospun PAN fibers.

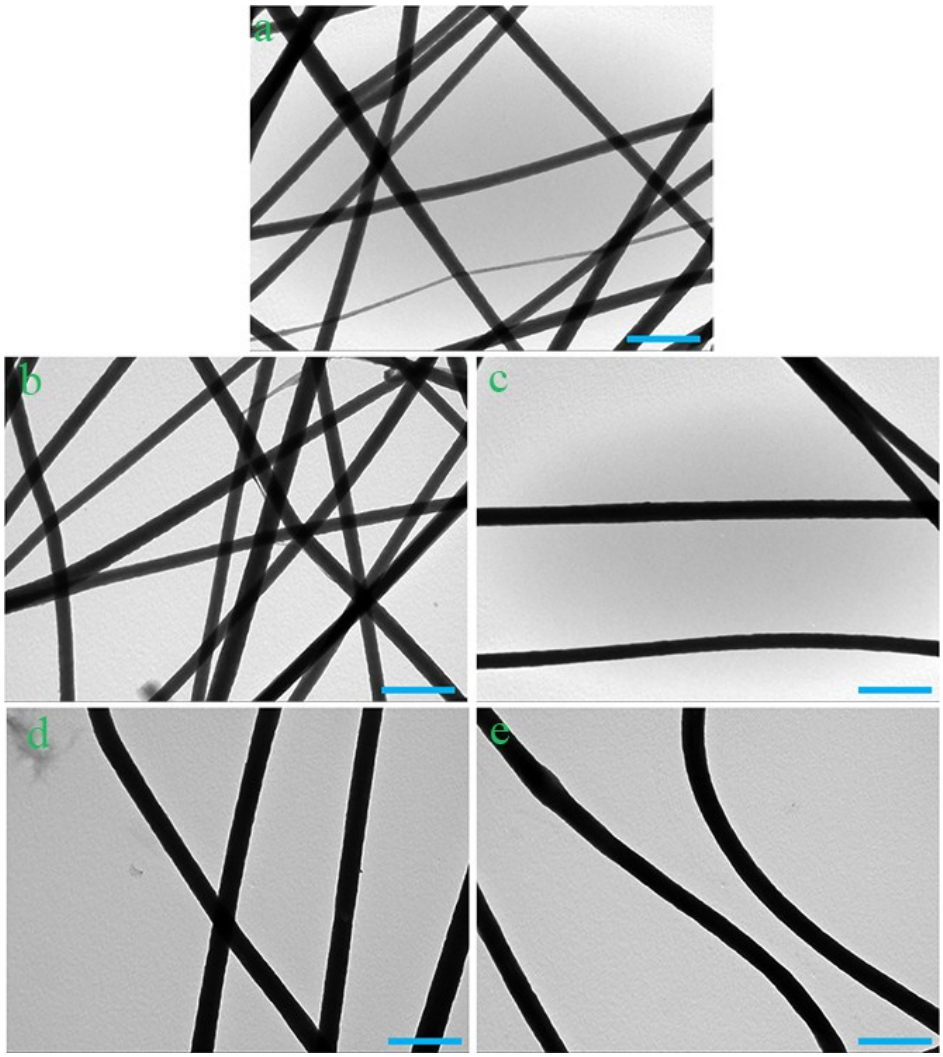

Fig. S4 TEM images of (a) EPANF, (b) bPEI-EPAN-2, (c) bPEI-EPAN-4, (d) bPEI-EPAN-8, and (e) bPEI-EPAN-12 (the bars are all 2 μm).

Table S1 Comparison of the maximum adsorption capacity (q_m) of Cr(VI) onto bPEI-EPAN with other adsorbents.

adsorbents	q_m (mg/g)	initial pH	T (°C)	Ref
amino functionalized GO decorated with Fe_3O_4nanoparticles	124.5	2.0	25	[1]
polyethylenimine modified biochar	435.7	2.0	30	[2]
polyethylenimine-functionalized PVA magnetic microspheres	88.4	2.0	25	[3]
polyethylenimine modified ethyl cellulose	36.8	3.0	NR	[4]
polyvinylamine modified polyester fibers	26.2	3.0	20	[5]
electrospun nanofibrous polyethylenimine mat	108.9	3.0	25	[6]
magnetic nanoparticles functionalized by polyethyleneimine	159.0	2.0	25	[7]
"Flower-Like'' PA6@$Mg(OH)_2$ electrospun nanofibers	296.4	2.0	25	[8]
Polyethylenimine modified poly(glycidyl methacrylate) microspheres	505.1	2.0	25	[9]
b-PEI grafted electrospun PAN fiber membrane	637.5	2.5	20	This work

[a]NR, not reported.

References

1 D. Zhao, X. Gao, C. Wu, R. Xie, S. Feng and C. Chen, *Appl. Surf. Scie.*, 2016, **384**, 1.

2 Y. Ma, W. J. Liu, N. Zhang, Y. S. Li, H. Jiang and G. P. Sheng, *Bioresource Technol.*, 2014, **169**, 403.

3 X. Sun, L. Yang, Q. Li, Z. Liu, T. Dong and H. Liu, *Chem. Eng. J.*, 2015, **262**, 101.

4 B. Qiu, J. Guo, X. Zhang, D. Sun, H. Gu, Q. Wang, H. Wang, X. Wang, X. Zhang, B. L. Weeks, Z. Guo and S. Wei,*ACS Appl. Mater. Interfaces*, 2014, **6**, 19816.

5 T. Mayer-Gall, K. Opwis and J. S. Gutmann, *J. Mater. Chem. A.*, 2015, **3**, 386.

6 Y.Ma, B. Zhang, H. Ma, M. Yu, L. Li and J. Li, *RSC Adv.*, 2016, **6**, 30739

7 B. Chen, X. Zhao, Y. Liu, B. Xu and X. Pan, *RSC Adv.*, 2015, **5**, 1398.

8 B. B. Jia, J. N. Wang, J. Wu and C. J. Li, *Chem. Eng. J.*, 2014, **254**, 98.

9 X. Sun, L. Yang, H. Xing, J. Zhao, X. Li, Y. Huang and H. Liu, *Colloids Surf., A: Physicochem. Eng.Aspects*, 2014, **457**, 160.

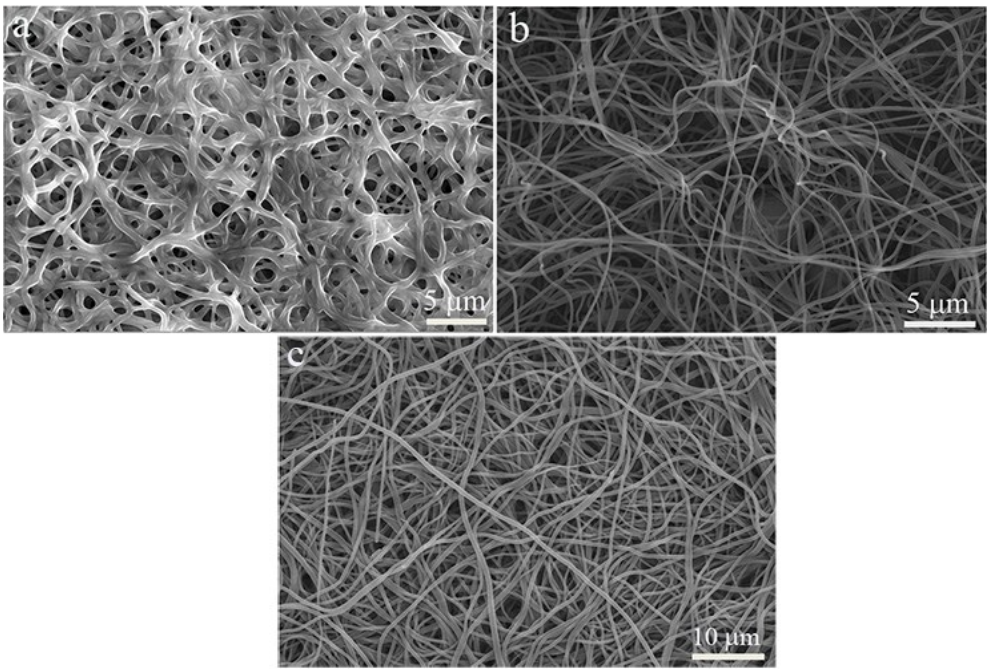

Fig. S5 SEM images of bPEI/PVA (a), bPEI-PAN(ht) (b) and bPEI-EPAN after ten adsorption-regeneration cycles (c).

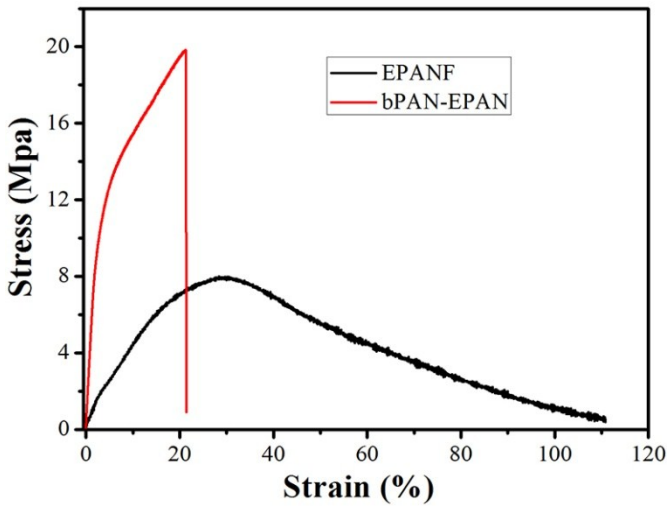

Fig. S6 Stress-strain curves of EPANF and bPEI-EPAN.

Table S2 Mechanical properties of EPANF and bPEI-EPAN.

sample	tensile strength (MPa)	Elongation at break (%)	Young's modulus (MPa)
EPANF	7.91±0.22	30.59±1.33	56.18±2.47
bPEI-EPAN	20.97±1.70	20.43±0.96	455.05±3.02

Each measurement was repeated at least three times. Young's modulus was determined from the initial slope of the stress–strain curves.

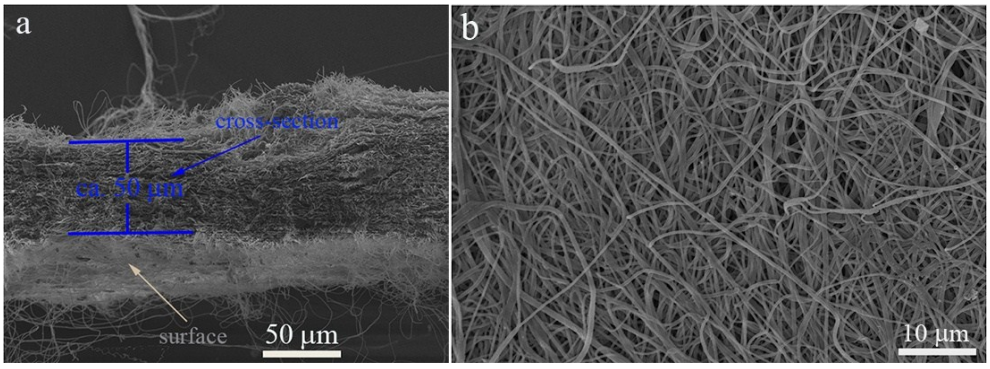

Fig. S7 SEM images for cross-section part of the membrane (a) and the bPEI-EPAN after ten filtration-regeneration cycles (b).

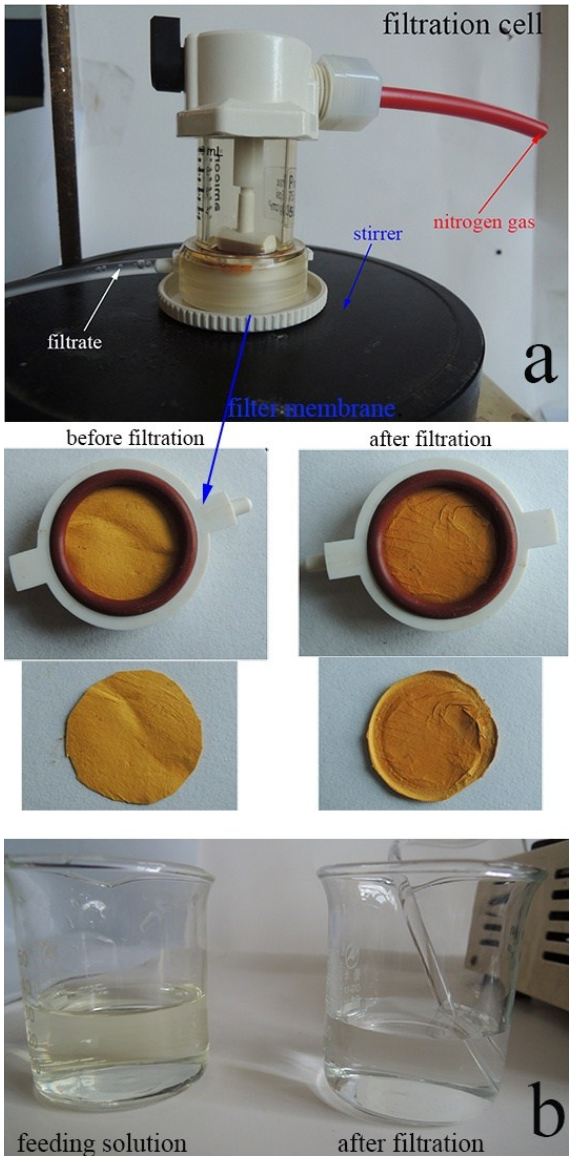

Fig. S8 (a) The filtration cell; and (b) the Cr(VI) solution before and after filtration.

Table S3 Filtration of the real water sample (initial Cr(VI) concentration: 0.208 mg/L) by bPEI-EPAN filter membranes of different thickness.

membranes thickness (μm)	concentrations in the filtrate (mg/L)
50	0.037
100	0.034
150	0.032
250	0.031

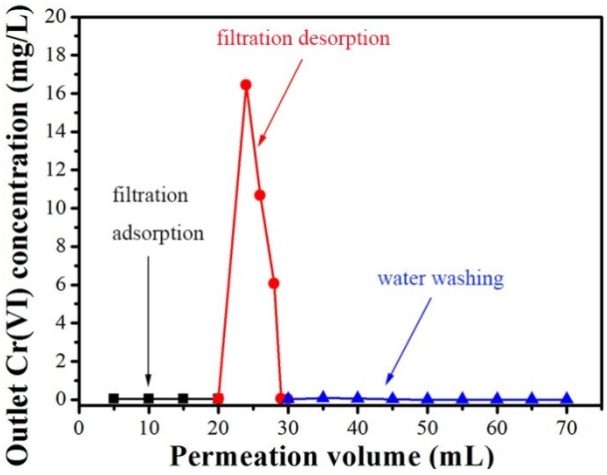

Fig. S9 Adsorption and desorption of Cr(VI) from aqueous solution through filtration.