

**Supplementary Information for**

**Magnetic Copper Hexacyanoferrate Core-shell Nanoparticles  
for Effective Cesium Removal from Aqueous Solution**

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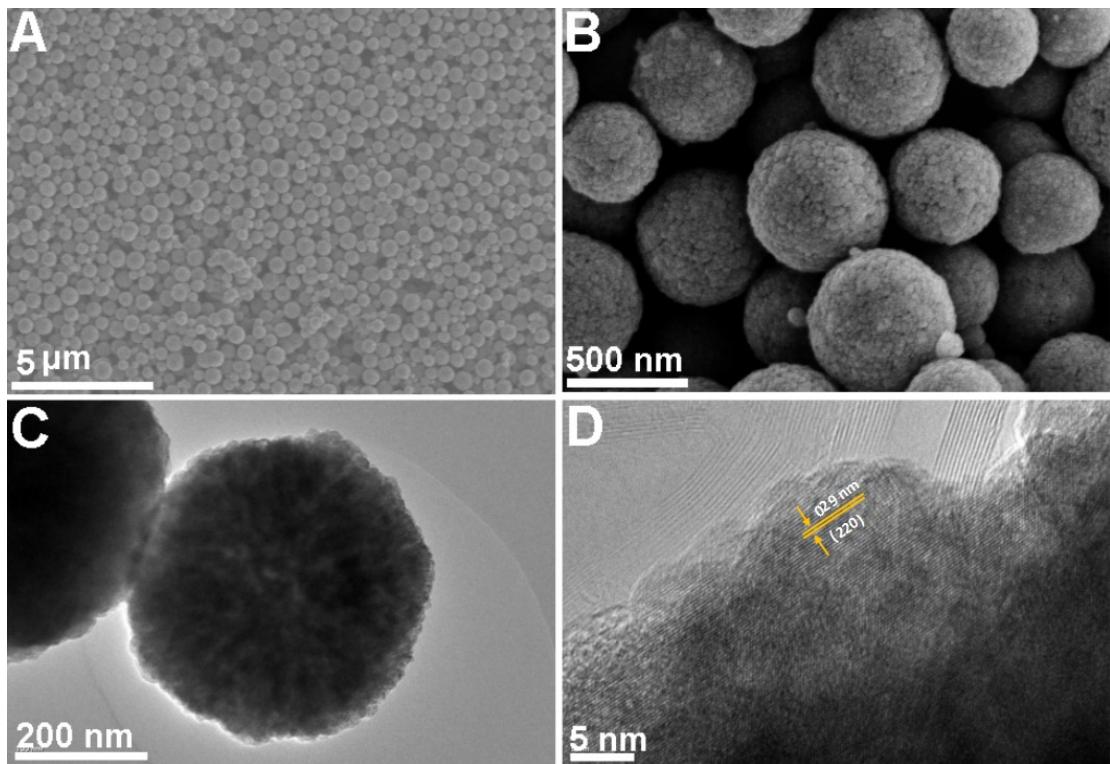
<sup>3</sup> Library of Zhejiang Normal University, Zhejiang Normal University, Jinhua,  
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**Figure S1**

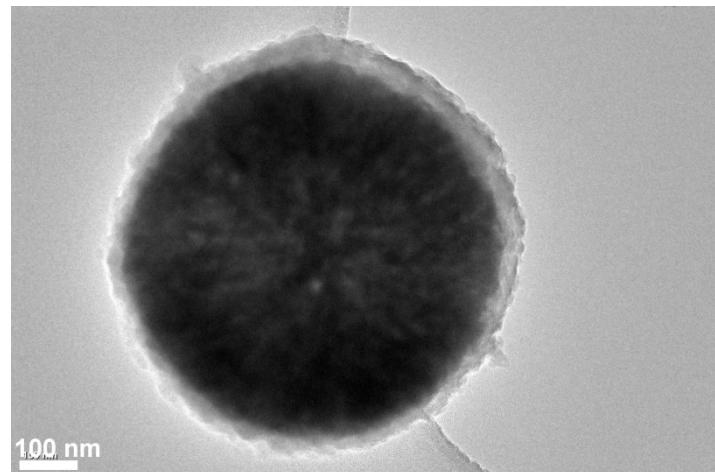
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**Figure S1** SEM images of  $\text{Fe}_3\text{O}_4$  NPs under different magnification: (A) 5  $\mu\text{m}$  and (B) 500 nm. TEM images of  $\text{Fe}_3\text{O}_4$  NPs under different magnification: (C) 200 nm and (D) 5 nm.

**Figure S2**



**Figure S2** TEM images of PDDA @ $\text{Fe}_3\text{O}_4$  nanoparticles.

**Table S1** Comparison on the maximum adsorption capacity ( $Q_{\max}$ ) and distribution coefficient ( $K_d$ ) of CuHCF@ $\text{Fe}_3\text{O}_4$  nanocomposites with recently reported literature.

Materials	Performance	$Q_{\max}$ $\text{mg}\cdot\text{g}^{-1}$	$K_d$ $\text{L}\cdot\text{g}^{-1}$	T K	pH	Ref
PBMX-III <sub>sphere</sub>	315.9	10.3	298	5-10	[1]	
PB-CMCNF	130	3.06	298	7	[2]	
PBA/PVC	152.8	1.04	298	6	[3]	
EA-CuHCF	452.5	23.4	298	7	[4]	

HCF-SA	114	100	298	8	[5]
PB@PAAM	374	3.6	298	7	[6]
KCuHCFS	74.7	27.1	298	4	[7]
Nano-PBA <sub>Cu</sub>	95.8	6.5	298	5	[8]
PAAc/Lap-HCF	146.2	130	298	7	[9]
PB@PD	54.34	57	298	6	[10]
Fe <sub>3</sub> O <sub>4</sub> -CTS-NaCuHCFe NPs	161.3	446.7	318	5	[11]
KCuFC-HMSS	13.1	53.1	308	6	[12]
CuHCF/poly-urushiol	214	1000	298	7	[13]
3D rGO/PBAs	204.9	58	298	5	[14]
KNiHCF-loaded PAN	59.2	156	298	9	[15]
ZnHCF-ZDC	204.9	104	298	7	[16]
D-Mt-Mag-HCF	159.2	82	298	8	[17]
CuHCF@Fe <sub>3</sub> O <sub>4</sub> NPs	268	250	298	7	This study

## Reference

- [1] A. Shahzad, M. Moztahida, K. Tahir, B. Kim, H. Jeon, A. A. Ghani, N. Maile, J. S. Jang, D. S. Lee, Highly effective prussian blue-coated MXene aerogel spheres for selective removal of cesium ions, *J . Nucl. Mater.*, 2020, 539, 152277-152286.
- [2] S. Eun, H. -J. Hong, H Kim, H. S. Jeong, S. Kim, J. Jung, J. Ryu, Prussian blue-embedded carboxymethyl cellulose nanofibril membranes for removing radioactive cesium from aqueous solution, *Carbohydr. Poly.*, 2020, 235, 115984-115991.
- [3] S. Q. Chen, J. Y. Hu, Y. F. Guo, N. Belzile, T. L. Deng, Enhanced kinetics and super selectivity toward Cs<sup>+</sup> in multicomponent aqueous solutions: A robust Prussian

blue analogue/polyvinyl chloride composite membrane, Environ. Res.,2020, 189, 109952-109960.

[4] C. Ma, Z. Jiang, S. Han, Y. Guo, T. Deng, Novel one-pot solvothermal synthesis of high-performance copper hexacyanoferrate for Cs<sup>+</sup> removal from wastewater, J. Chem., 2021, 2021,3762917-3762925.

[5] Y. H. Kim, H. H. Eom, D. H. Kim, D. Harbottle, J. W. Lee, Adsorptive removal of cesium by electrospun nanofibers embedded with potassium copper hexacyanoferrate, Sep. Purif. Technol., 2021, 255, 117745-117752.

[6] Y. Jung, U. S. Choi, Y. G. Ko, Securely anchored Prussian blue nanocrystals on the surface of porous PAAm sphere for high and selective cesium removal, J. Hazard. Mater., 2021, 420, 126654-126663.

[7] A.M. Soliman, H.A. Madbouly, E.S. El Sheikh, M. Khalil, A. Massad, Selective removal and immobilization of cesium from aqueous solution using sludge functionalized with potassium copper hexacyanoferrate: a low-cost adsorbent, J. Radioanal. Nucl. Chem., 2021, 330, 207-223.

[8] W. X. Han, Y. Huang, M. H. Su, H. Y. Liu, C. J. Shen, Y. Zhou, T. Ou, D. Y. Chen, Highly selective adsorption and lattice process of cesium by cubic cyanide-based functional materials, Environ. Res., 2022, 214, 114085-114094

[9] B. Gao, H. -R. Yu, H. -Y. Zhang, T. Liang, C. -J. Cheng, High-density immobilization of potassium copper hexacyanoferrate in poly(acrylic acid)/laponite hydrogel for enhanced Cs<sup>+</sup> removal, J. Environ. Chem. Eng., 2022, 10, 107979-107989.

[10] S. Yoon, M. Choi, Y. Hwang, S. J. Bae, Upcycling of steel slag for manufacture

of Prussian-blue-encapsulated pectin beads and its use for efficient removal of aqueous cesium, J. Clean. Prod., 2021, 319, 128786-12878

[11] T. T. Xia, L. L. Yin, Y. H. Xie, Y. Q. Ji, Efficiently remove of Cs(I) by metals hexacyanoferrate modified magnetic Fe<sub>3</sub>O<sub>4</sub>-chitosan nanoparticles, Chem. Phys. Lett., 2020, 746, 137293-137300.

[12] X. Y. Peng, J. H. Zheng, J. S. Wang, C. Xiang, R. Wang, Synthesis of hollow mesoporous silica spheres functionalized with copper ferrocyanide and its application for Cs<sup>+</sup> removal, Environ. Sci. Pollut. Res., 2022, 29, 53509-53521.

[13] H. Shen, L.D. Zhu, Q. Lin, S. J. Guo, H. G. Zhang, Urushiol-resourced dopamine analogue as a trigger to construct clay-hexacyanoferrate hydrogel for cesium removal, J. Environ. Chem. Eng., 2021, 9, 106140-106151.

[14] J. B. Huo, G. C. Yu, J. L. Wang, Selective adsorption of cesium (I) from water by Prussian blue analogues anchored on 3D reduced graphene oxide aerogel, Sci. Total Environ., 2021, 761, 143286.

[15] Y. Bondar, Y. Olkhovyk, S. Kuzenko, Nanocomposite adsorbent based on polyacrylonitrile fibers for rapid and selective removal of Cs radionuclides, J. Radioanal. Nucl. Chem., 2021, 330, 1221-1231.

[16] H. J. Kim, H. H. Eom, Y. H. Kim, D. Harbottle, J. W. Lee, Reversible electro-mediated cesium ion removal using a zeolitic imidazolate framework derived zinc hexacyanoferrate composite, Chem. Eng. J., 2022, 450, 138029-138039.

[17] L. D. Zhu, D. Q. Zhu, Y. Sheng, J. J. Xu, D. Harbottle, H. G. Zhang, Polydopamine-coated magnetic montmorillonite immobilized with potassium copper

hexacyanoferrate for selective removal of  $\text{Cs}^+$  and its facile recovery, Appl. Clay Sci.,  
2022, 216, 106367-106377.