Electronic Supplementary Information for

Functionalization of tailored porous carbon monolith for de-contamination of radioactive substances

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S1. Surface modification of silica particles

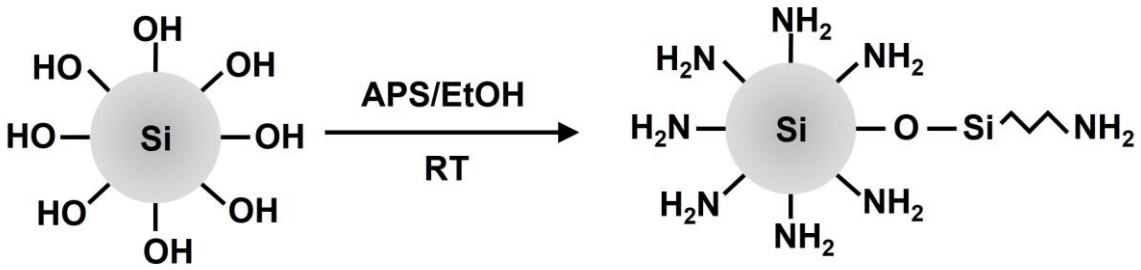

Figure S1. Schematic illustration for the surface modification mechanism during silanization reaction.

Table S1. The zeta potential values of silica particles before and after 3- aminopropyl-trimethoxysilane (APS) silane modification

Sample	Temperature (°C)	Zeta potential (mV)	Mobility (µmcm/Vs)	Conductivity (mS/cm)
Before modification	25	– 4.03	– 0.08145	0.0107
After modification	25	+ 6.17	0.1246	0.00178

[a] These values are acquired by zeta potential analyzer (Zetasizer Nano-ZS, Malvern)

S2. EDS elemental analysis data

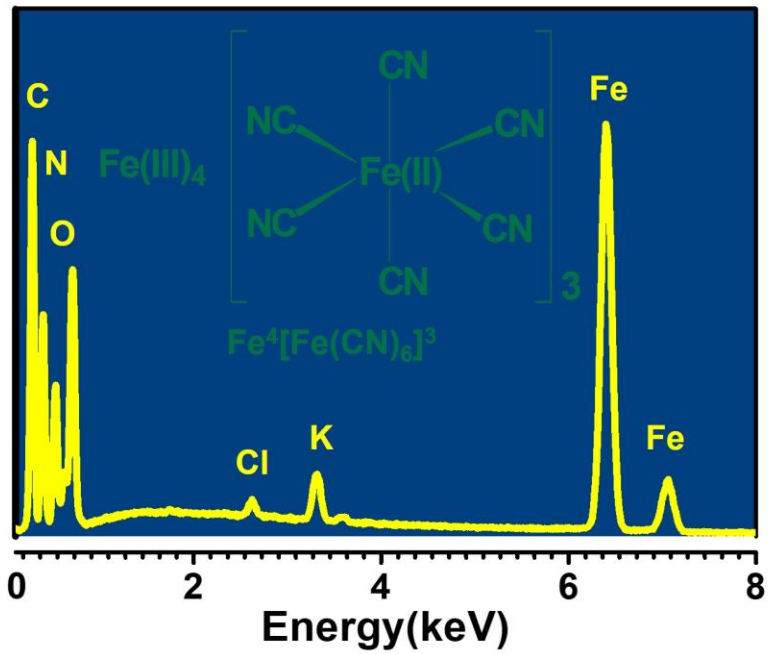

Figure S2. EDS spectrum of the PB@PCM

Table S2. Elemental analysis results of the PB and PB@PCM

Sample	Atomic ratio [a] (%)				
	C	N	O	Fe	Cl
PB	37.93	32.91	13.18	15.55	0.24
PB@PCM	41.15	35.26	13.31	9.6	0.13

S3. Pore characterizations

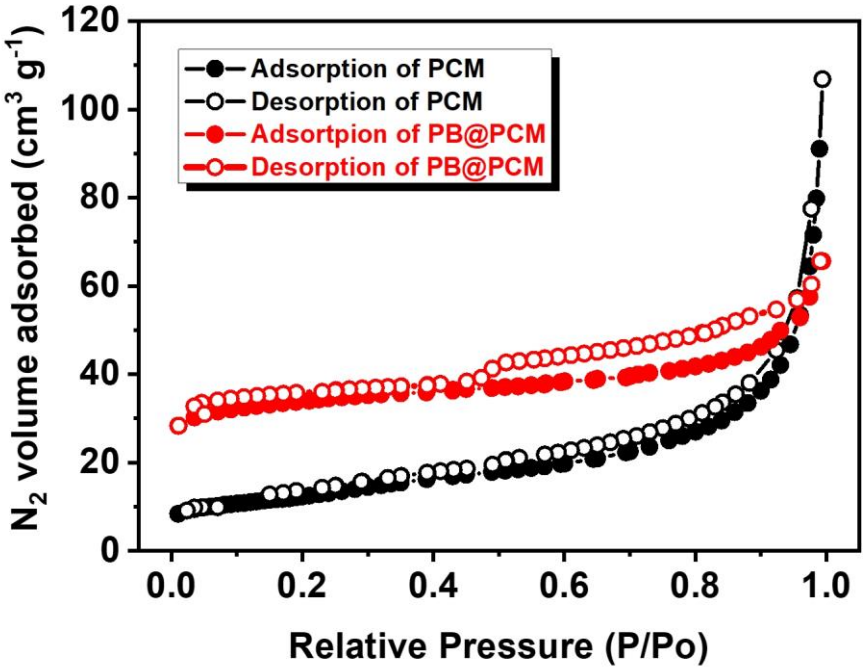

Figure S3. Pore characterization of the PCM and the PB@PCM. The BET surface areas and nitrogen adsorption–desorption isotherms were measured at 78 K using BELSORP-mini II analysis program.

S4. Comparison of adsorption capacities

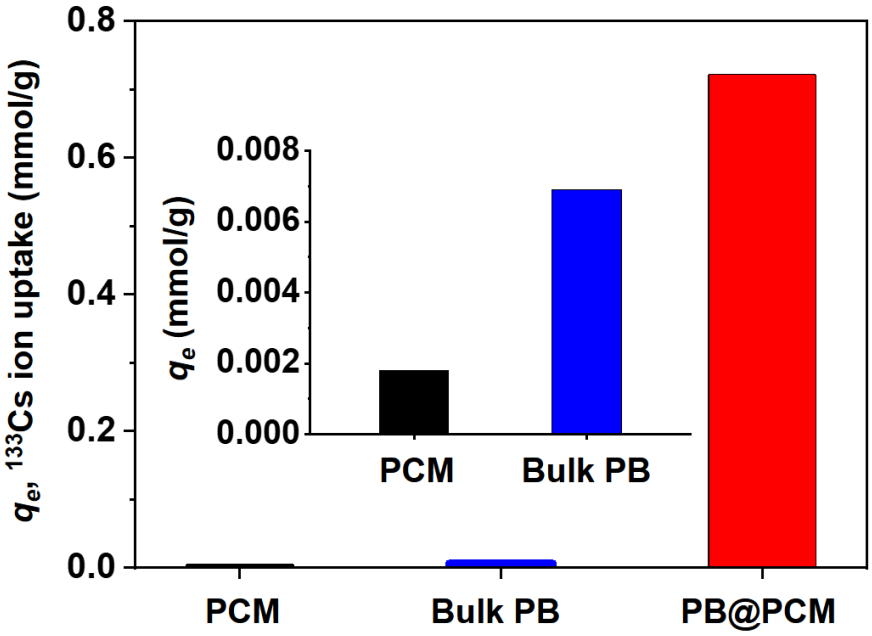

Figure S4. Comparison of adsorption capacities of the PCM (black color), bulk PB (blue color) and PB@PCM (red color) for removal of ^{133}Cs. Adsorption test were performed at pH 7.0 and 20.0°C for 24 h, and initial ^{133}Cs ion concentration is 100 ppm.

S5. A compilation of different investigations using various PB-based adsorbents

Table S3. Adsorption capacities of various PB-based adsorbents for cesium ion removal from solution

Adsorbent	Adsorption parameters	q_{max} (mg/g)	Ref.
COP-PAC-PB	Adsorbent amount: 0.01-5 g. Initial concentration: 50 mL of 10 ppm Cs solution. Contact time: 24 h. Temperature: RT	19.0	[1]
PB/Fe_3O_4/GO	Adsorbent amount: 50 mg. Initial concentration: 30 mL of 50-300 ppm Cs solution. Contact time: 24 h. Temperature: 25°C. pH: 7.0	55.6	[2]
PB-coated MNP	Adsorbent amount: 25 mg. Initial concentration: 4 mL of 50-2,780 ppm Cs solution. Contact time: 24 h.	96.0	[3]
PB/RGOF	Adsorbent amount: 10 mg. Initial concentration: 4 mL of 1-500 ppm Cs solution. Contact time: 12 h.	18.7	[4]
PB-MCs	Adsorbent amount: 30 mg. Initial concentration: 50 mL of 5-60 ppm Cs solution. Contact time: 4 h. Temperature: 20°C. pH: 5.5	4.8	[5]
PB/PAN	Initial concentration: 50 mL of 2-100 ppm Cs solution. Contact time: 24 h. Temperature: 25°C. pH: 7.0	93.4	[6]
PB@PCM	Adsorbent amount: 100 mg. Initial concentration: 100 mL of 100 ppm Cs solution. Contact time: 24 h. Temperature: 20°C. pH: 7.0	98.5	This work

S6. Atomic properties of radionuclides

Table S4. Atomic properties of various radioactive materials

Element[a]	Electro-negativity	Ionization energy (kJ/mol)			Atomic radious	Covalent radius
		1st	2nd	3rd	(pm)	(pm)
Cesium (Cs)	0.79	375.7	2234.3	3400.0	265	244 ± 11
Rubidium (Rb)	0.82	403.0	2632.1	3859.4	248	220 ± 9
Barium (Ba)	0.89	502.9	965.2	3600.0	222	215 ± 11
Strontium (Sr)	0.95	549.5	1064.2	4138.0	215	195 ± 10
Cerium (Ce)	1.12	534.4	1050.0	1949.0	181	204 ± 9
Thallium (Tl)	1.62	589.4	1971.0	2878.0	170	145 ± 7

[a] Several elements were selected as representative radionuclides.

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