Supporting information for:

Polyethyleneimine-nano silica composites: A low−cost and promising adsorbent for CO_2 capture

Kaimin Li,[a] Jianguo Jiang,[*,a,b,c] Sicong Tian,[a] Feng Yan,[a] Xuejing Chen [a]

[a]School of Environment, Tsinghua University, Beijing 100084, P. R. China

[b]Key Laboratory for Solid Waste Management and Environment Safety, Ministry of Education of China, P. R. China

[c]Collaborative Innovation Center for Regional Environmental Quality

Table S1. Experiment protocol and elemental analysis for pain silica and PEI-silica adsorbents

Sample	Silica (g)	PEI (g)	C, H, and N content (wt%)			PEI content (wt%)
			C	H	N	
Plain silica	-	-	0.068	0.65	0.00	-
10% PEI-silica	2	0.22	5.55	1.61	3.47	9.91
20% PEI-silica	2	0.50	10.75	2.63	6.29	18.95
30% PEI-silica	2	0.86	16.66	3.85	9.41	29.20
35% PEI-silica	2	1.23	19.61	4.78	11.51	35.18
40% PEI-silica	2	1.51	23.10	5.53	13.49	41.40
50% PEI-silica	2	2.26	27.46	6.57	16.15	49.47
60% PEI-silica	2	3.88	34.21	7.91	19.98	61.39

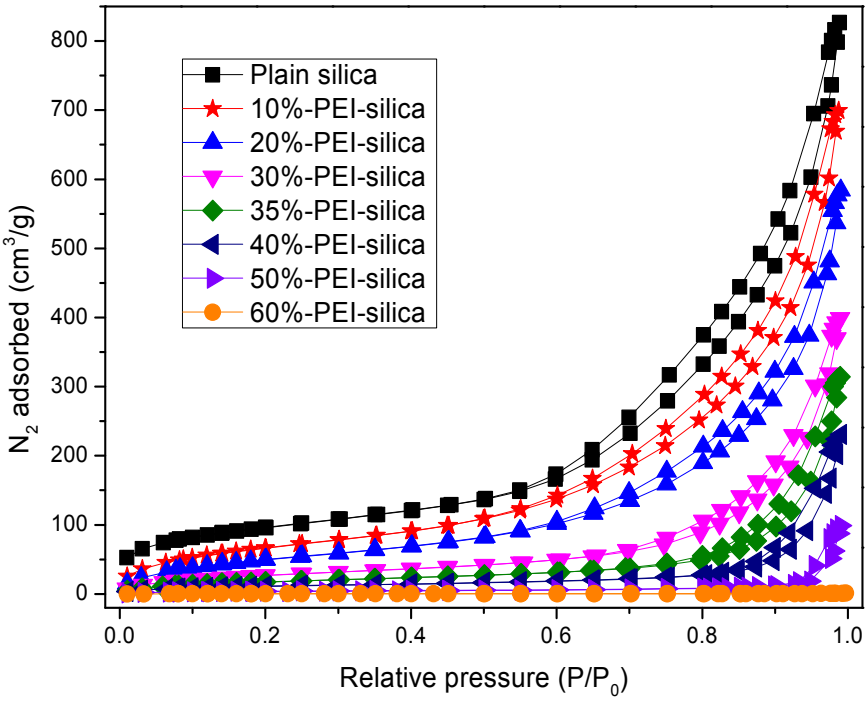

Figure S1. N_2 adsorption−desorption isotherms for plain silica and PEI-silica adsorbents with varied PEI content.

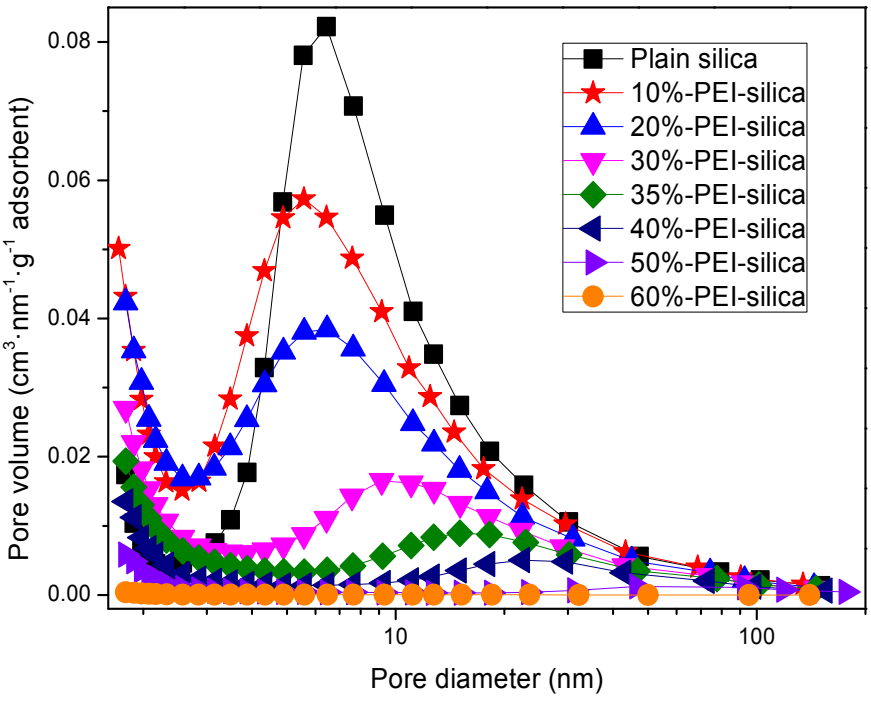

Figure S2. Pore distribution of plain silica and PEI−silica adsorbents with different PEI content.

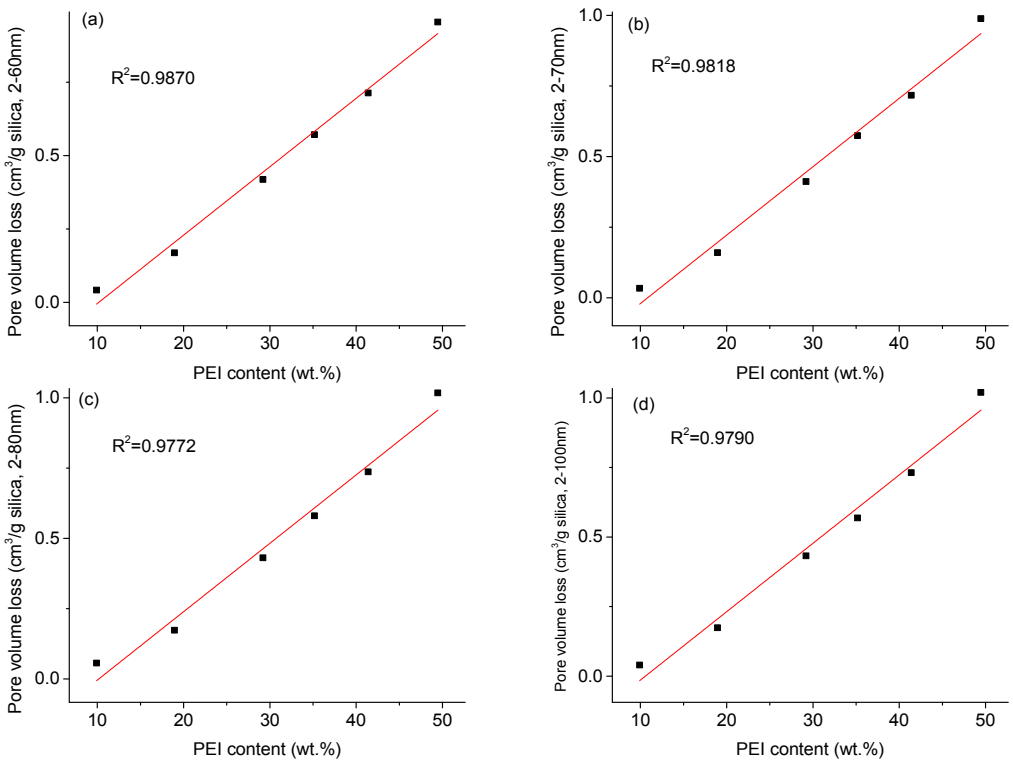

Figure S3. The relationship between the PEI loading content and the pore volume loss in the range: (a) 2-60nm, (b) 2-70nm, (c) 2-80nm, (d) 2-100nm.

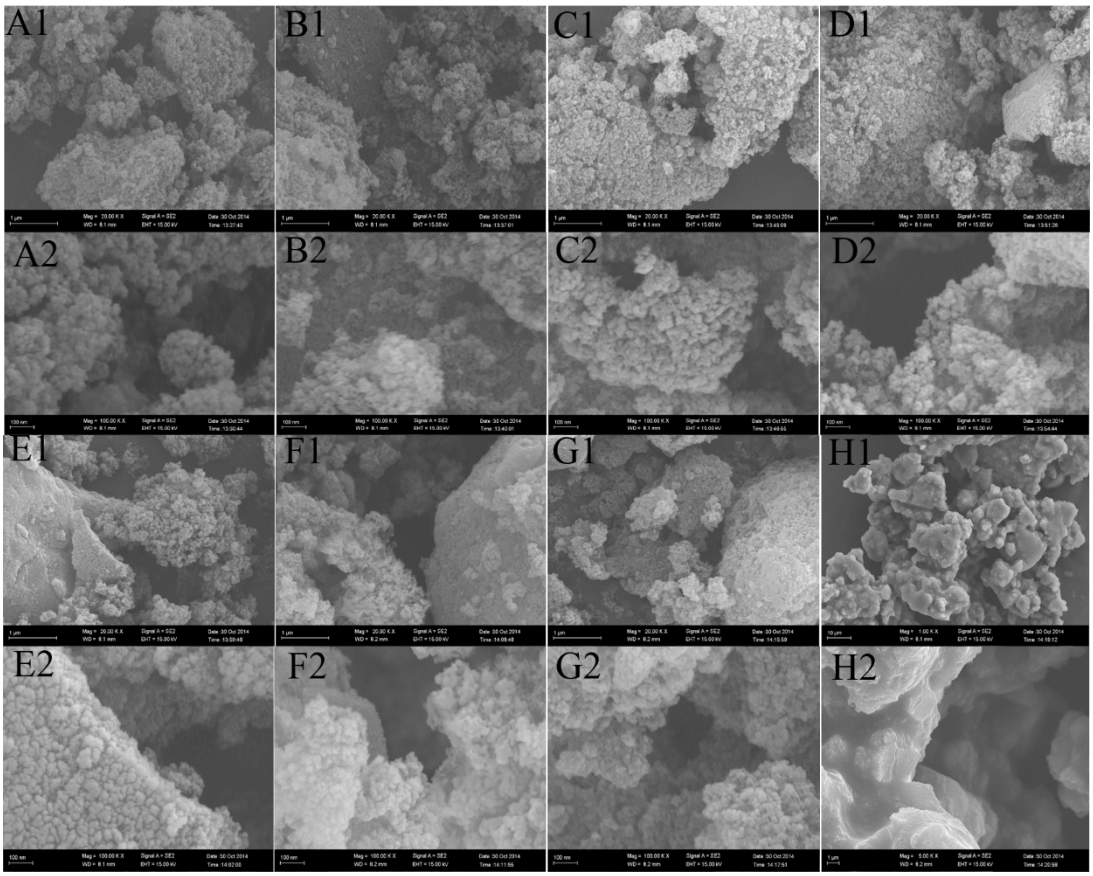

Figure S4. SEM images for PEI-nano silica adsorbents: A1 and A2 for plain silica, B1 and B2 for 10%-PEI-silica, C1 and C2 for 20%-PEI-silica, D1 and D2 for 30%-PEI-silica, E1 and E2 for 35%-PEI-silica, F1 and F2 for 40%-PEI-silica, G1 and G2 for 50%-PEI-silica, H1 and H2 for 60%-PEI-silica.

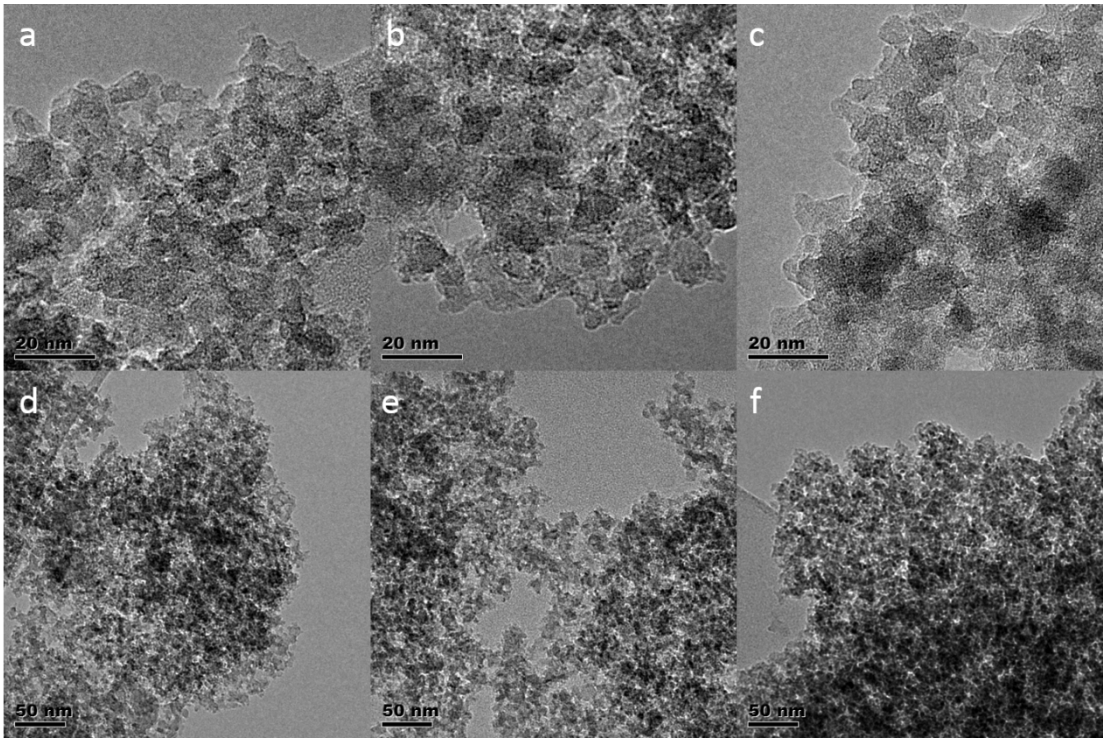

Figure S5. TEM image for plain silica (a, d), 30% PEI-silica (b, e) and 60% PEI-silica (c, f).

Table S2. BET surface area, pore volume, and average pore diameter for plains silica and PEI−silica adsorbents with different PEI content.

Sample	BET (m^2/g)	Total pore volume (cm^3/g)	Average pore diameter (nm)
Plain silica	337	1.28	15.20
10%-PEI-silica	253	1.08	17.09
20%-PEI-silica	193	0.90	18.75
30%-PEI-silica	104	0.62	23.70
35%-PEI-silica	68	0.49	28.73
40%-PEI-silica	42	0.36	33.79
50%-PEI-silica	15	0.15	41.70
60%-PEI-silica	0.65	0.0016	9.69

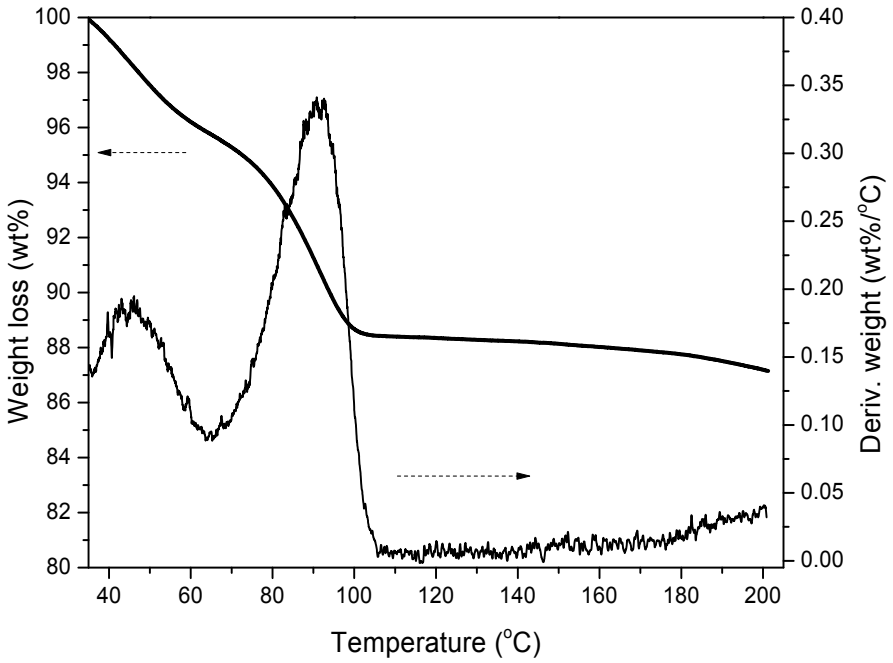

Figure S6. Thermo-gravimetric analysis for 60%-PEI-silica, temperature range is from 30 to 200°C, heating rate is 2°C/min, and is under N_2 with a flow rate 20 ml/min.

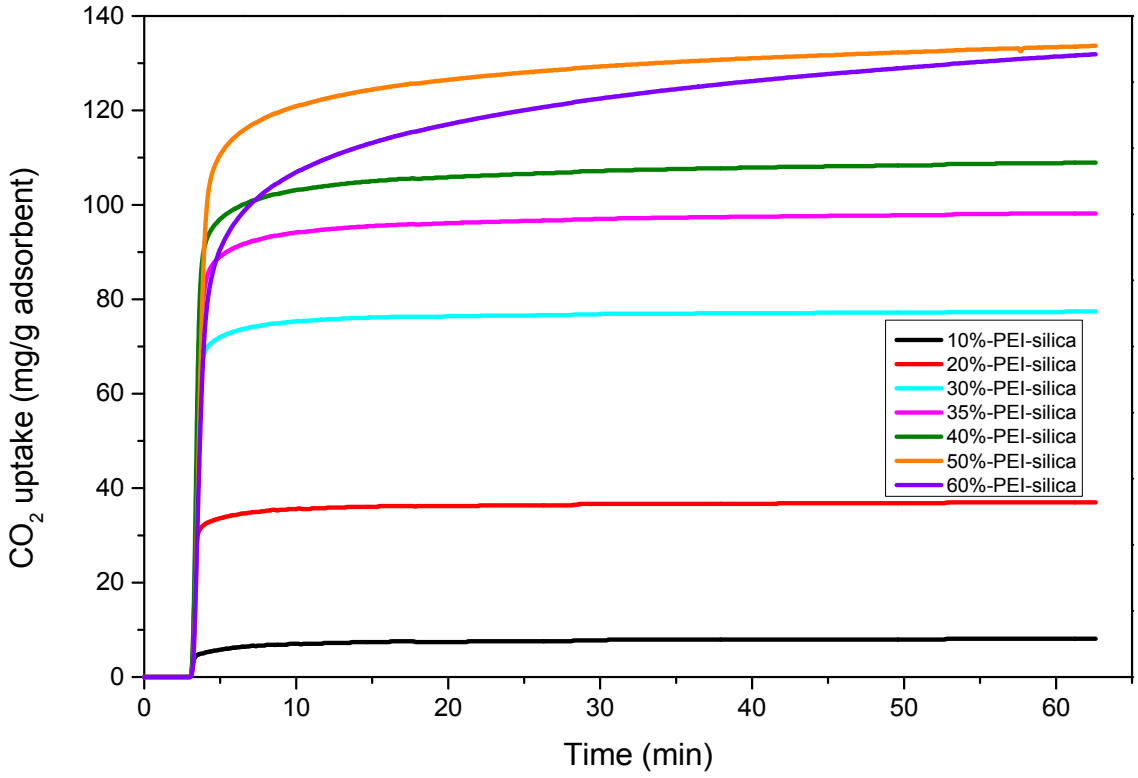

Figure S7. CO_2 adsorption isotherms for PEI-nano silica adsorbents under 0.15atm CO_2 partial pressure.

Table S3. CO_2 adsorption capacity for PEI-nano silica.

Sample	Adsorption capacity (mg/g adsorbent)					
	45°C [a]	60°C [a]	75°C [a]	90°C [a]	105°C [a]	75°C (15% CO_2)
10%-PEI-silica	28	24	19	16	12	8
20%-PEI-silica	61	59	55	50	42	37
30%-PEI-silica	96	98	97	93	84	77
35%-PEI-silica	103	110	118	123	116	98
40%-PEI-silica	107	116	127	133	128	109
50%-PEI-silica	110	120	138	160	159	134
60%-PEI-silica	95	114	137	165	186	132

[a] adsorption capacity under 100% CO_2.

Table S4. CO_2 adsorption capacity for PEI-nano silica.

Sample	Adsorption capacity (mg/g PEI)				
	45°C	60°C	75°C	90°C	105°C
10%-PEI-silica	287	246	195	159	119
20%-PEI-silica	323	312	290	262	222
30%-PEI-silica	328	335	331	320	287
35%-PEI-silica	290	310	332	344	325
40%-PEI-silica	260	280	306	321	309
50%-PEI-silica	223	242	279	323	321
60%-PEI-silica	155	186	224	268	304