Support information

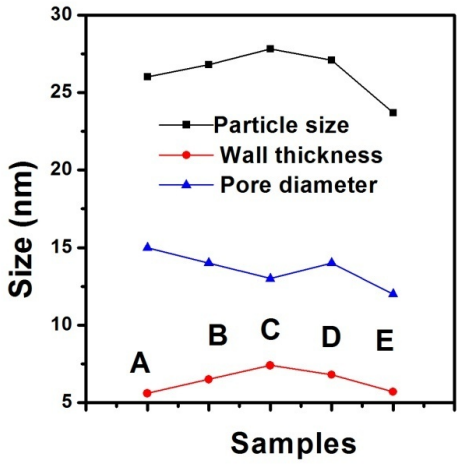

Fig. S1 The diagram of particle size (■), wall thickness (●) and pore diameter (▲) of different HOSs. A-E is HOSs-5% (A), HOSs-10% (B), HOSs-15% (C), HOSs-20% (D) and HOSs-25% (E), respectively.

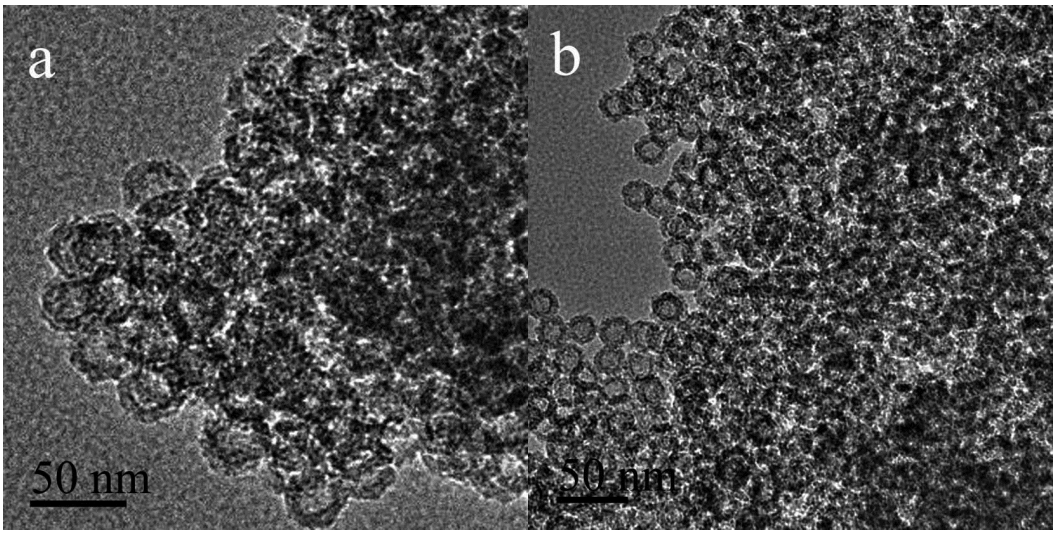

Fig. S2 TEM images of HOSs-5% (a) and HOSs-25% (b) without DMDMOS added.

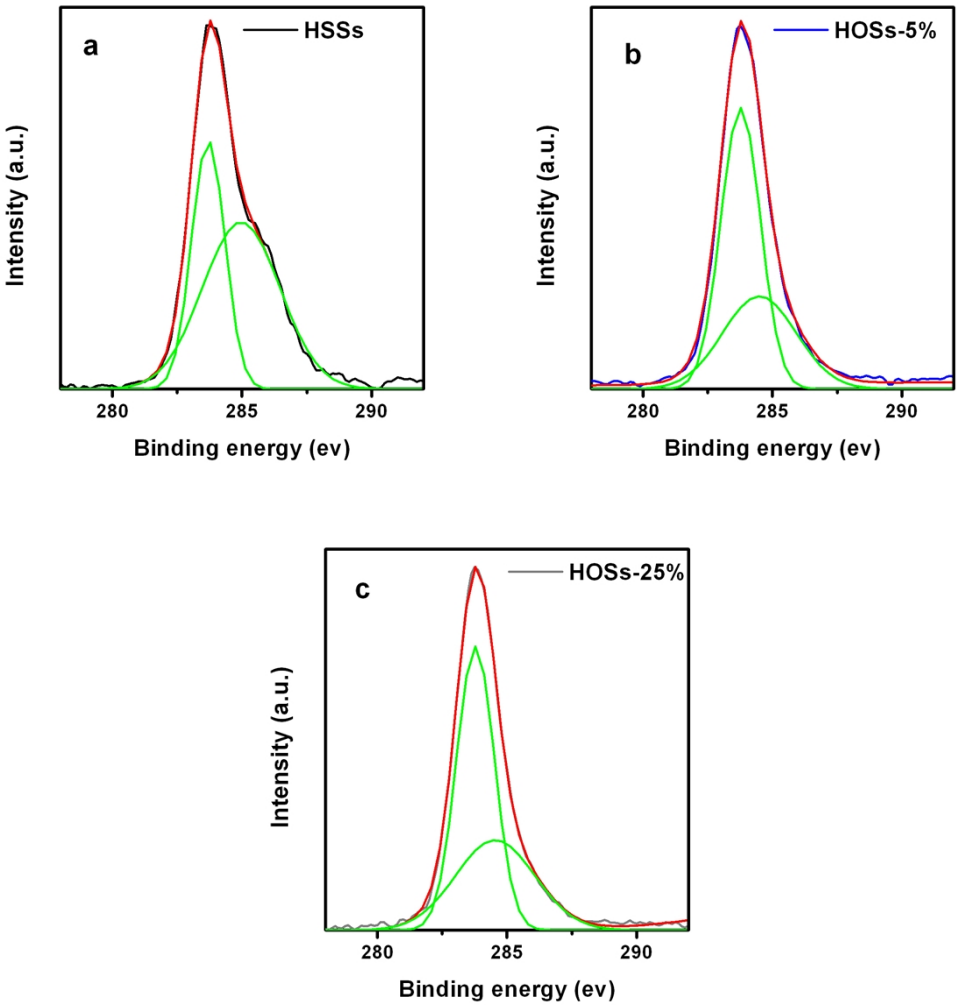

Fig. S3 C1s XPS spectra of different hollow spheres.

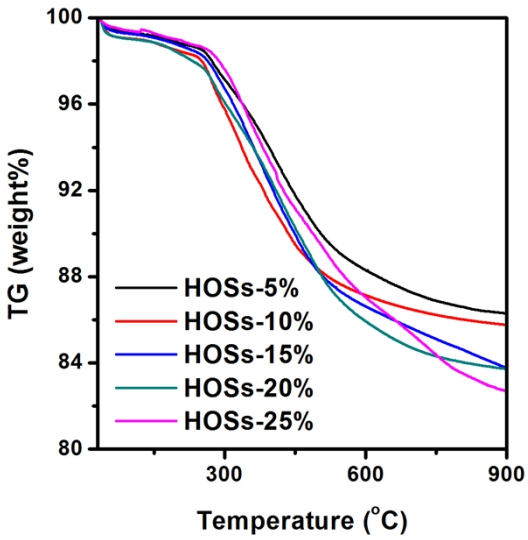

Fig. S4 TGA profile HOSs-5% (A), HOSs-10% (B), HOSs-15% (C) HOSs-20% (D) and HOS-25% (E).

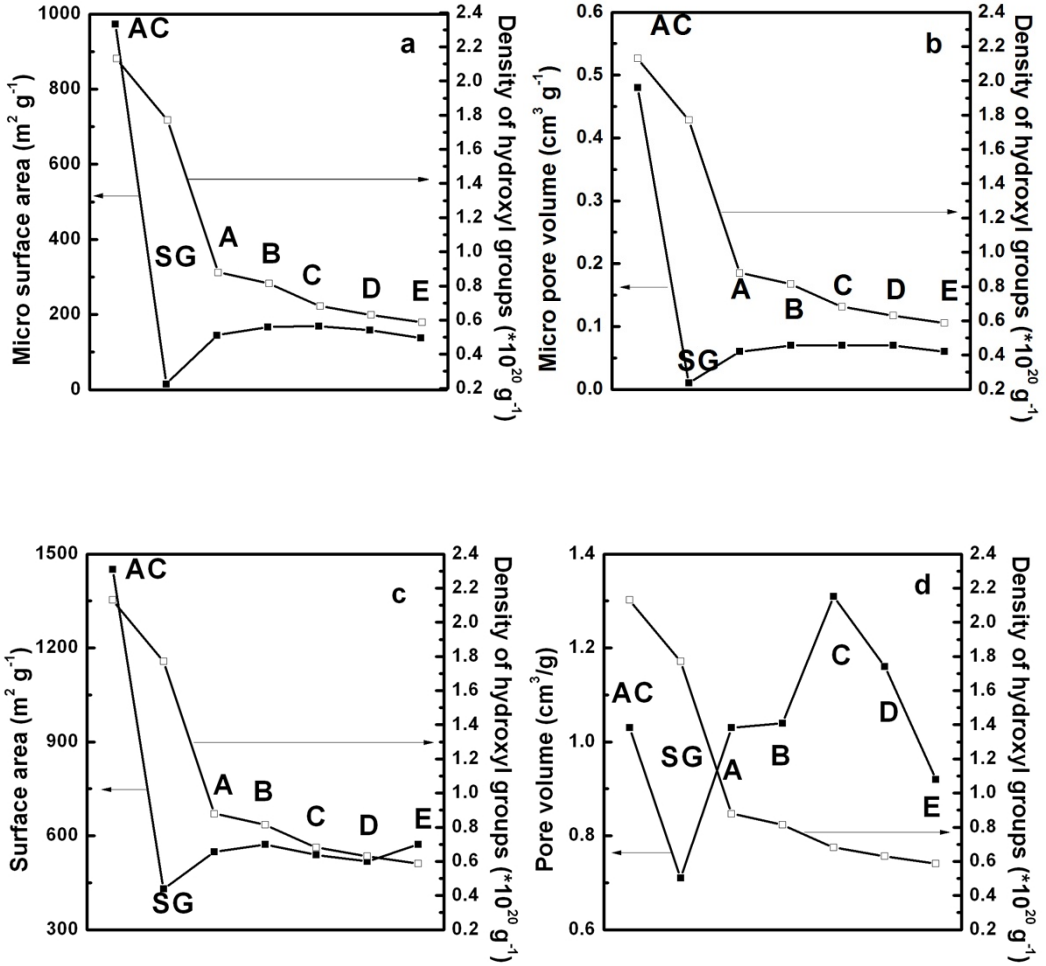

Fig. S5 Relationship between density of surface hydroxyl group and structure parameters of different samples, micro surface area (a), micro pore volume (b), surface area (c) and pore volume (d), respectively. A-E is HOSs-5% (A), HOSs-10% (B), HOSs-15% (C), HOSs-20% (D) and HOSs-25% (E), respectively.

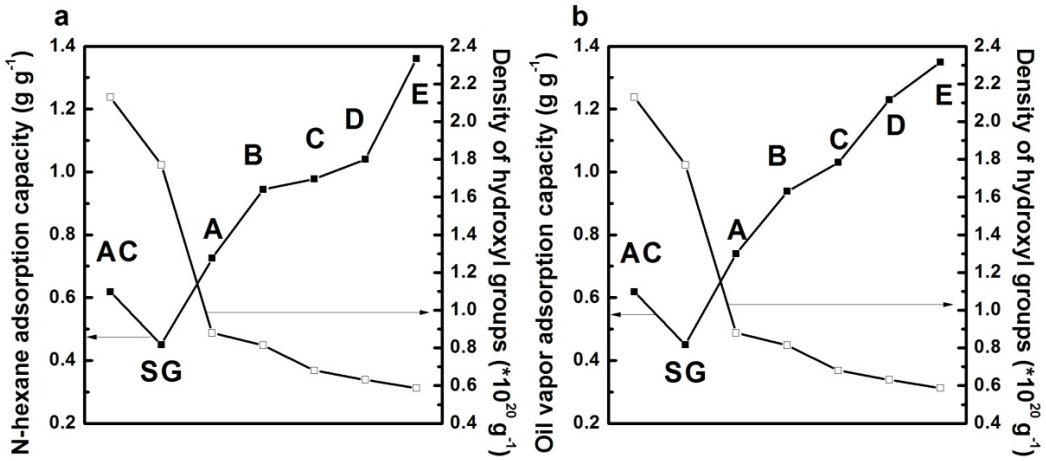

Fig. S6 Relationship between static adsorption capacity and the density of surface hydroxyl group of different samples, n-hexane (a) and 93# gasoline (b). A-E is HOSs-5% (A), HOSs-10% (B), HOSs-15% (C), HOSs-20% (D) and HOSs-25% (E), respectively.

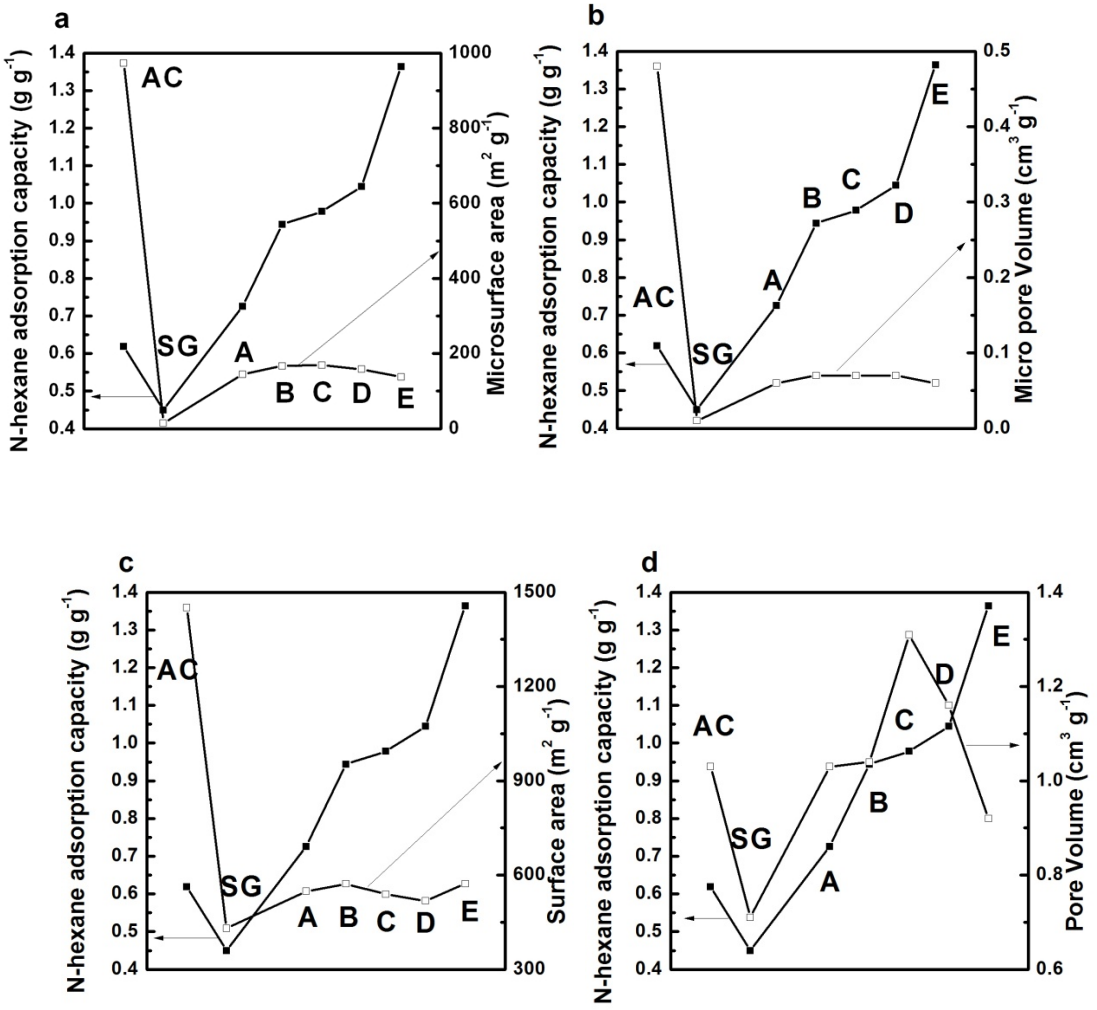

Fig. S7 Relationship between static n-hexane adsorption capacity and structure parameters of different samples, micro surface area (a), micro pore volume (b), surface area (c) and pore volume (d), respectively. A-E is HOSs-5% (A), HOSs-10% (B), HOSs-15% (C), HOSs-20% (D) and HOSs-25% (E), respectively.

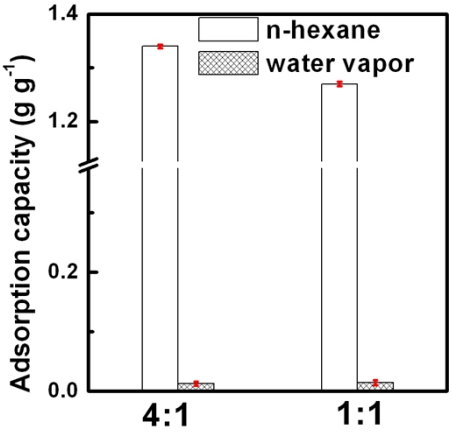

Fig. S8 Static competitive adsorption of n-hexane and water vapor from triplicate measurements with the adsorbates of n-hexane and water volume ratio of 4:1 and 1:1.

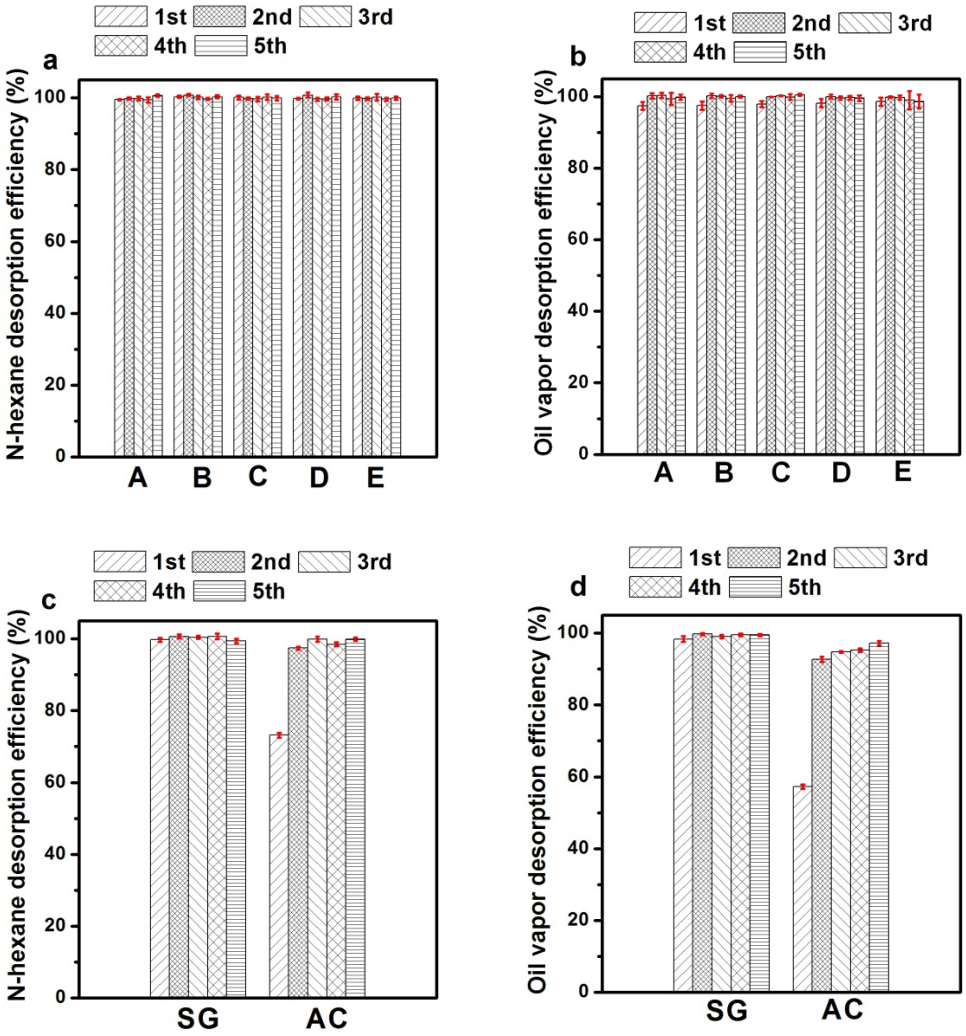

Fig. S9 The histograms of desorption efficiency from triplicate measurements for different HOSs, n-hexane (a), 93# gasoline (b), respectively and the histograms of desorption efficiency for AC and SG, n-hexane (c), 93# gasoline (d), respectively.

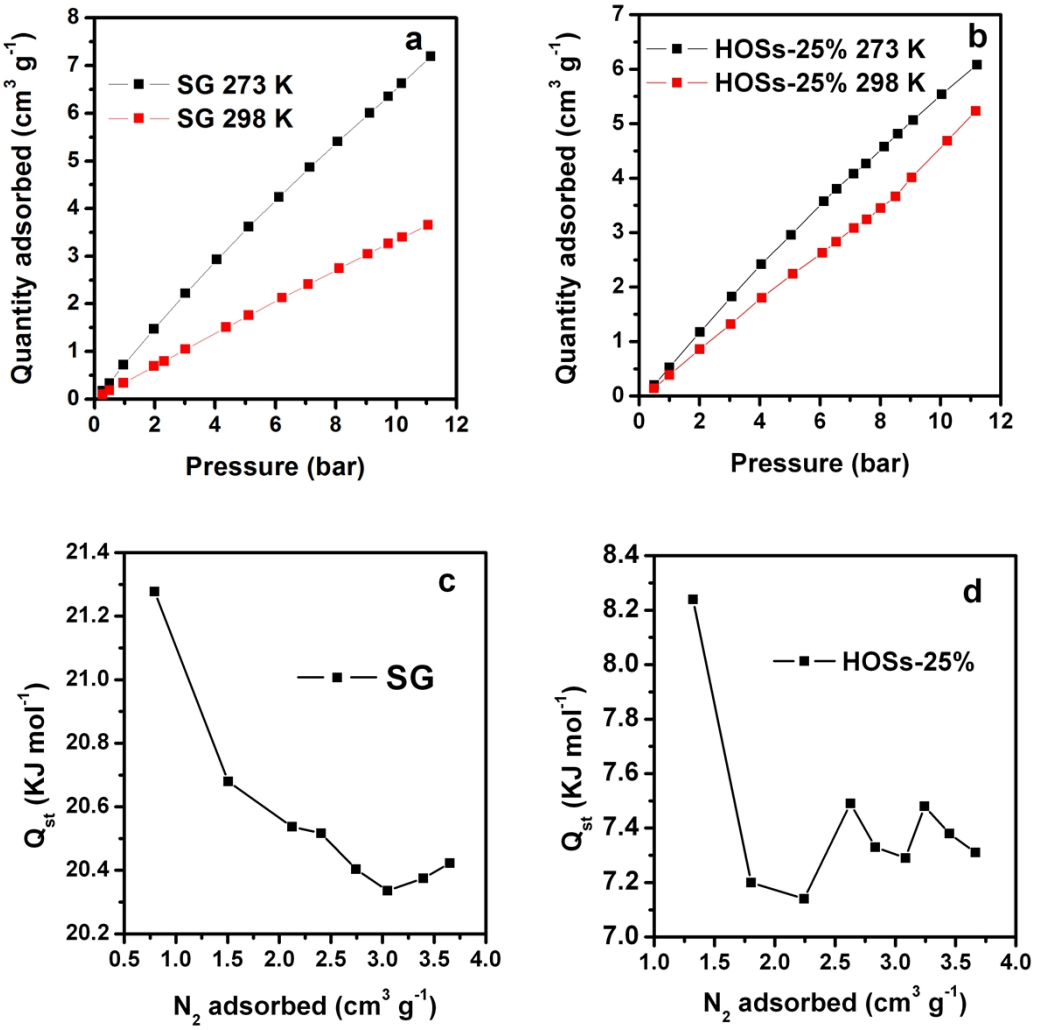

Fig. S10 N_2 sorption isotherms of SG (a) and HOS-25% (b) at 273 K and 298 K, and isosteric heats of adsorption for N_2 on SG (c) and HOS-25% (d).

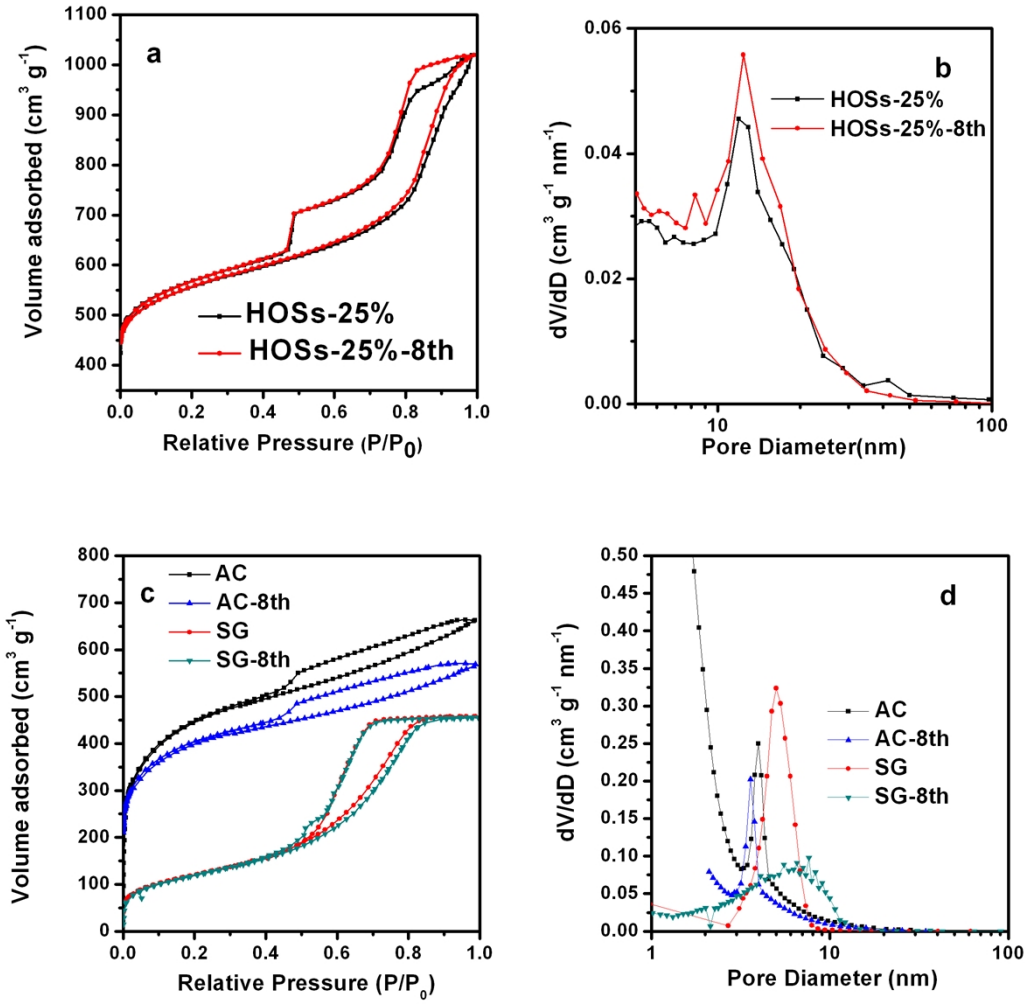

Fig. S11 N_2 adsorption-desorption isotherms (a and c) and pore size distributions (b and d) of commercial AC-8th, SG-8th and HOSs-25%-8th as compared to AC, SG and HOSs-25% before adsorption.

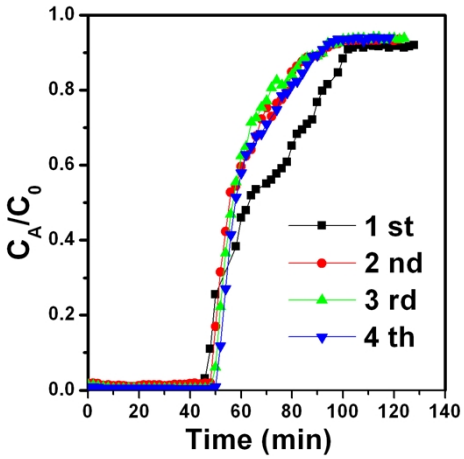

Fig. S12 The breakthrough curves for n-hexane of HOS-25% using water-saturated carrier gas (▲) with total flow rate of 0.135 L min^{-1} and the flow rate of n-hexane of 0.1 L min^{-1}, respectively.

Table S1 Surface chemistry composition characterized by XPS of HSSs, HOSs-5% and HOSs-25%.

Sample	C (at.%)	O (at.%)	Si (at.%)
HSSs	28.73	48.16	23.11
HOSs-5%	32.02	44.09	23.89
HOSs-25%	30.30	45.49	24.21

Table S2 The static n-hexane adsorption capacity, theoretically calculated weight of SiO_2 and organo groups (CH_2 and CH_3 fragments) for different HOSs, and theoretically calculated and measured weight ratio of organo groups from TGA results.

Samples	a (g g^{-1})	b (g)	c (g)	d (%)	e (%)
HOSs-5%	0.726	0.552	0.132	19.2	11.4
HOSs-10%	0.944	0.567	0.138	19.6	12.0
HOSs-15%	0.978	0.581	0.145	20.0	13.5
HOSs-20%	1.04	0.596	0.152	20.3	13.9
HOSs-25%	1.36	0.616	0.159	20.7	15.1

Note: a is the static n-hexane adsorption capacity; b and c are theoretically calculated weight of SiO_2 and organo groups, respectively; d and e is theoretically calculated and measured weight ratio of organo groups from TGA results, respectively.

It is assumed that all the silica sources are consumed in the synthesis and form the silica framework of the HOSs, and HOSs-5% was taken as an example to show the detail the calculation process.

The initial composition of the silica sources of is TEOS ($4.57*10^{-3}$ mol), BTSE ($2.40*10^{-4}$ mol), and DMDMOS ($4.17*10^{-3}$ mol). The total mole of Si is $4.57*10^{-3}+2.40*10^{-4}*2+4.17*10^{-3}=9.22*10^{-3}$, so the final weight of SiO_2 is $9.22*10^{-3}*60$ =0.552 g. The mole of C in BTSE is $2.40*10^{-4}*2=4.80*10^{-4}$, and the mole of C in DMDMOS is $8.34*10^{-3}$. The total C and H element weight is $4.80*10^{-4}*14+8.34*10^{-3}*15$=0.132 g. So the weight percent of CH_2 and CH_3 is 0.132/(0.132+0.552)=19.2%.

Table S3 The n-hexane adsorption (Ad) capacities and desorption (De) efficiencies of triplicate static adsorption experiments (5 adsorption-desorption cycles).

Cycle / Exp	1 st Ad. ($g\ g^{-1}$)	1 st De (%)	2 nd Ad ($g\ g^{-1}$)	2 nd De (%)	3 rd Ad ($g\ g^{-1}$)	3 rd De (%)	4 th Ad ($g\ g^{-1}$)	4 th De (%)	5 th Ad ($g\ g^{-1}$)	5 th De (%)
1	1.3551	99.70	1.3762	99.65	1.3819	99.89	1.3559	100.1	1.3701	99.74
2	1.3516	100.5	1.3715	99.86	1.3796	100.3	1.3621	99.83	1.3613	99.91
3	1.3583	99.70	1.3711	100.3	1.3874	99.59	1.3634	99.53	1.3808	99.18
Ave	1.355	99.97	1.373	99.94	1.382	99.92	1.360	99.82	1.371	99.61
STD	0.0034	0.46	0.0028	0.33	0.0040	0.35	0.0040	0.29	0.0098	0.38

Note: Due to the mass loss of the sample, the percentage of desorption might be higher than 100%. Ave means average, STD stands for standard derivation.

Table S4 Structural parameters of the different samples, before adsorption and after the 8th dynamic adsorption-desorption cycle.

Samples	S_{BET} ($m^2\ g^{-1}$)	S_m ($m^2\ g^{-1}$)	V_t ($cm^3\ g^{-1}$)	V_m ($cm^3\ g^{-1}$)
AC	1451	973	1.03	0.48
AC-8th	999	366	0.72	0.18
SG	430	15	0.71	0.01
SG-8th	427	16	0.70	0.01
HOSs-25	572	138	0.92	0.06
HOSs-25-8th	576	126	0.96	0.05

Table S5 Comparison of dynamic adsorption parameters of n-hexane on HOSs-25% using water-saturated carrier gas between 4 times.

HOSs-25%	Breakthrough time (min)	t_e (min)	q_t (g g^{-1} adsorbent)	$q_{n\text{-hexane}}$ (g g^{-1} adsorbent)	q_t (g g^{-1} adsorbent)	q_{water} (g g^{-1} adsorbent)	$q_{n\text{-hexane}}$ / q_{water}	Desorption efficiency (%)
1st	48	104	1.43	1.41	1.43	0.0231	61.3	98.6
2nd	50	102	1.39	1.37	1.39	0.0191	72.1	99.2
3rd	50	102	1.42	1.40	1.42	0.0179	77.8	98.9
4th	52	100	1.44	1.42	1.44	0.0180	78.8	99.4