Supporting information

Experimental Section

Synthesis and modification of SBA-15. In a typical synthesis, 1.6g (0.32m mol) of $EO_{20}PO_{70}EO_{20}$ (P_{123}) and 2.2g (30m mol) kCl were dissolved in 60g of 2.0M HCl at 39±1°C. To this solution, 4.2g (20m mol) of (TEOS) tetraethyl orthosilicate was added under vigorous stirring. The final molar-composition of the reactants is 0.02 P123/1.5 kCl/6 HCl/166 H_2O/1 TEOS. After stirring for 10 min, the mixture was kept in static conditions at the same temperature for one day, then the mixture was transferred into an autoclave and heat at 40 °C for another 24h. The solid product were collected by filtration and dried at 60 °C in air. The resulting powders were calcinated at 350 °C to obtain mesoporous SBA-15.

For the synthesis of -SH /-NH_2 modified SBA-15, 0.01mol 3-mercaptopropyltrimethoxysilane or aminopropyltrimethoxysilane and 3.0g SBA-15 were added to 60ml toluene, the mixture was stirred at 110 °C for 12h, then the solid was collected by filtration and dried at 60 °C in air. For synthesis of SBA-15-COOH, 3-Cyanopropyltrimethoxysilane was used to modifying the -CN group on the surface first, then the solid was added to 100ml 50% H_2SO_4 and stirred at 110 °C for 12h to hydrolyzed the -CN group.

Determination of the Zeta-Potential The zeta-potential of SBA-15 was determined with a Malvern Zetasizer Nano Series. The Zeta-potential measurements were conducted at 25°C. 5 mg of the materials were dispersed in 20 ml of 0.06% kNO_3 solution.

Fourier transform infrared spectroscopy The FT-IR spectra of the samples were recorded on a Thermo Nicolet 380 spectrometer in the 3600−400 cm^{-1} region via the KBr pellet method.

Transmission electron microscopy TEM images were recorded on a HT7700 operated at 100 Kv.

Elemental analysis Elemental analysis were performed with Vario MICROCHN elemental analyser (EA).

BET Analysis The BET specific surface area, average pore size, and pore volume of the SBA-15 were determined by N_2 adsorption/desorption isotherms at 77.15 K using a Micromeritics ASAP 2020 automatic surface area and porosity analyzer (Micromeritics Instrument Corp., Norcross, GA). The SBA-15 were outgassed for 3 h at 473.15 K on the degas port of the analyzer before test.

Anti-coagulant plasma Blood was taken from a healthy porcine. Sodium citrate (3.2%) was mixed with porcine blood in a ratio of 1:9 to prevent blood clotting. The whole blood was centrifuged at 4500 rpm for 8 min to separate the blood cells and platelets. The plasma was transferred to labeled tubes and stored at -20^{o}C until used.

Natural plasma The 0.2M $CaCl_2$ was added to the anti-coagulant plasma in a ratio of 1:20 to get the natural plasma. The clotting time of natural plasma at 25 ^{o}C is around 11 min. Natural plasma was got just before use and was never refrozen.

Plasma clot Plasma clot was formed by incubated different volumes of natural plasma at 25 ^{o}C for 15min and the procoagulant activity of the plasma clot was also determined.

HPC/SBA-15 composites. The SBA-15 was incubated with plasma (natural plasma or anticoagulant plasma) in a ratio of 1:2 to 1:8. The incubation time is ~15 min, then the procoagulant activity and the thrombin activity of the composites was determined.

In vitro **clotting assays.** An in vitro clotting assay was used to measure the procoagulant activity of the composite samples. The assay measured the coagulation response in terms of a clotting time (CT), defined as the time required from activation of the intrinsic pathway of the coagulation cascade to the appearance of a firm clot which stick to the wall of the polystyrene tube. The process had been extensively described in previous reports.[1-3] In a typical assay, 2.0 mL of porcine natural plasma was mixed with 50 mg of the hemostatic agent in a 5mL polystyrene tube (52mm×12mm). The assay tubes were capped with plastic caps, rotated at 30 rpm (~135^{o}) on a mute mixer and the corresponding CT was recorded. The clotting assays were all carried at 25 ^{o}C.

Thrombin chromogenic substrate assays. The concentration of thrombin Chromogenic substrate S2238 (HYPHEN BioMed) was $8*10^{-4}$M. The assay temperature was 37 ^{o}C. The procedure followed previous report.[2] The thrombin (Sigma-Aldrich) solution used in the thrombin chromogenic substrate assays had a concentration of 0.5~2 mg/mL.

SDS-PAGE and Western blot analysis. The HPC/SBA-15 composites (the SBA-15-SG was incubated with natural plasma or anticoagulant plasma in a ratio of 1:4) were washed with extensive water to remove the soft proteins with low affinity prior to the SDS-PAGE and Western blot experiments. The high-affinity proteins were retrieved from the SBA-15 surface by adding reducing SDS-sample buffer to the washed HPC/SBA-15 composites and boiling the solution. The proteins were then analyzed in 10% reducing SDS-PAGE. The protein bands were stained with coomassie brilliant blue. For western blot, samples were separated by 10% reducing SDS-PAGE and electroblotted onto a PVDF membrane. The membrane was then incubated for 2 h in TBS (containing 5~10% defatted milk). Afterward, the membrane was washed with de-ionized water and incubated with Rabbit polyclonal to Thrombin (Abcam, ab92621) for 12 h (over night). Then, the membrane was washed with TBST for three times and further incubated with secondary antibodies goat anti-rabbit IRDye 800CW for 2 h. After washing with TBST, densitometric band scanning was performed using an Odyssey infrared imaging system (LI-COR Biosciences).

BSA (bovine serum albumin) absorbed to materials surface. 20mg SBA-15 -COOH, SBA-15-NH_2 and SBA-15-OH materials were separately incubated with 200 μl 2.5mg/ml BSA solution for 10 minutes, then the solution was washed with extensive deionized water to remove the soft binding BSA prior to the SDS-PAGE. The hard protein corona was retrieved from the SBA-15 surface by adding reducing SDS-sample buffer to the SBA-15/BSA composites and boiling the solution. The proteins were then analyzed in 10% reducing SDS-PAGE. The protein bands were stained with coomassie brilliant blue.

Figure S1. The TEM of SBA-15-OH. TEM micrographs were obtained with a Hitachi HT-7700 transmission electron microscope operating at 100kV.

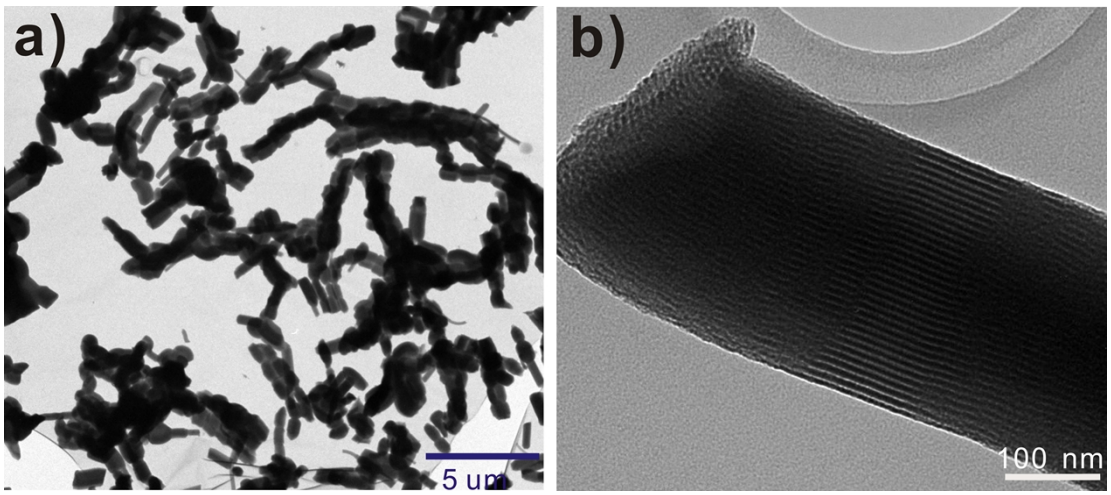


Table S1. The pore volume, surface area of -OH, -SH, -COOH and -NH_2 modified SBA-15.

Surface group	Surface area/(m^2/g)	Pore diameter/(nm)	Pore volume/(m^3/g)
SBA-15-OH	299	5.0	0.371
SBA-15-SH	293	4.7	0.346
SBA-15-COOH	275	5.1	0.356
SBA-15-NH2	188	4.7	0.230

Pore diameter, Pore volume and surface area were calculated from nitrogen sorption data based on BJH model from adsorption branch.

Figure S2. The FT-IR spectrum of group modified SBA-15. The presence of N-H bending vibration around 687 cm^{-1} and C-H stretching around 2940 cm^{-1} confirms the incorporation of amino groups. The presence of C=O stretching around 1720 cm^{-1} confirms the incorporation of carboxyl groups.

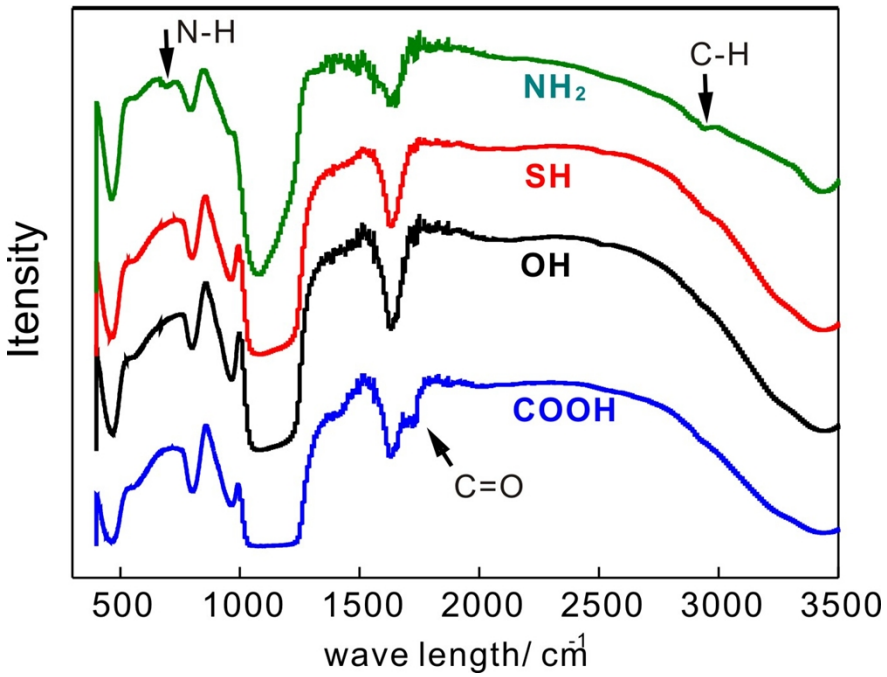


Table S2. The elemental analysis of SBA-15-SG (-SH, -COOH, -NH_2)

Sample	N/%	C/%	H/%
SBA-15-NH_2	2.49	9.16	2.67
SBA-15-SH	0.00	5.98	1.77
SBA-15-COOH	0.03	5.73	1.75
SBA-15-OH	0.00	0.30	1.86

The high carbon content of SBA-15-SG (-SH, -COOH, -NH_2) indicate that the -$(CH_2)_3SH$, -$(CH_2)_2COOH$ and -$(CH_2)_3NH_2$ functional group are successfully attached to the silica surface.

Figure S3. The SDS-PAGE of HPC on the surface of SBA-15-SG. The protein corona is separately formed by incubating SBA-15-SG with natural plasma or anticoagulant plasma in a ratio of 1:4 (50 mg/200 μl).

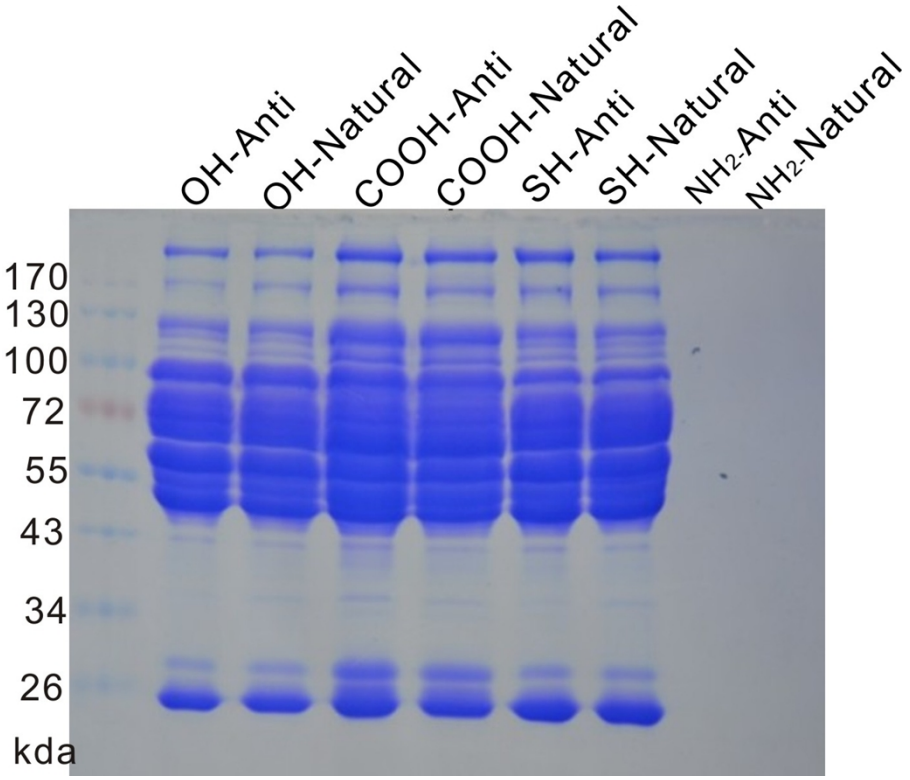


Figure S4. The clotting time of SBA-15-OH, natural plasma HPC/ SBA-15-OH (NP/SBA-15-OH) and anti-coagulant plasma HPC/ SBA-15-OH (ACP/ SBA-15-OH).

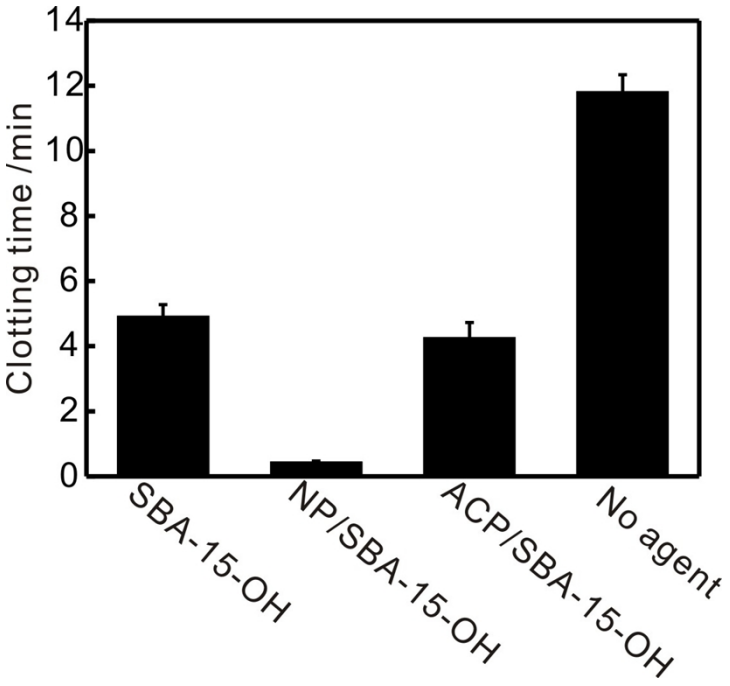


Figure S5. HPC formation on the surface of SBA-15-OH with different shapes, the rope-like SBA-15-OH was synthesized as Reference 12.

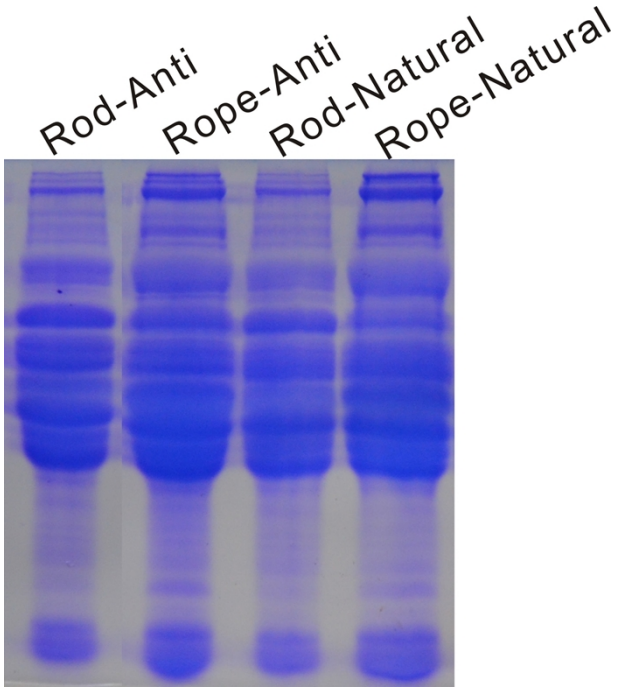
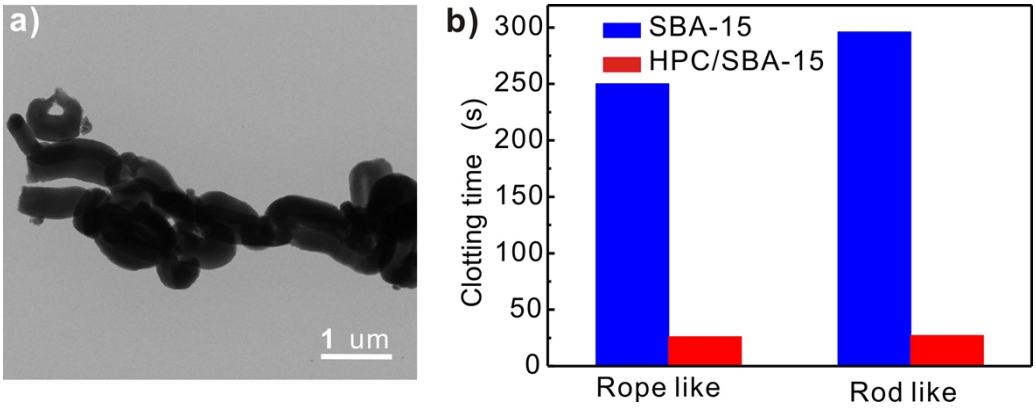


Figure S6. a) The TEM of rope-like SBA-15-OH. b) The procoagulant activity of SBA-15-OH with different shapes.



Reference:

[1] T. A. Ostomel, P. K. Stoimenov, P. A. Holden, H. B. Alam, G. D. Stucky, *Journal of Thrombosis and Thrombolysis* **2006**, *22*, 55.

[2] S. E. Baker, A. M. Sawvel, J. Fan, Q. Shi, N. Strandwitz, G. D. Stucky, *Langmuir* **2008**, *24*, 14254.

[3] S. E. Baker, A. M. Sawvel, N. Zheng, G. D. Stucky, *Chemistry of Materials* **2007**, *19*, 4390.