Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Dandelion-like Core-shell Silica Microspheres with Hierarchical Pores

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Materials

Tetraethyl orthosilicate (98%, TEOS), hexadecyltrimethylammonium chloride (≥98.0%, CTAC), ammonium fluoride (≥98.0%), cetylpyridinium chloride (≥98.0%, CPC), *N,N*-dimethylhexadecylamine (≥95%, DMHA) and ammonium hydroxide solution (28.0-30.0%) were obtained from Sigma-Aldrich (St. Louis, MO, USA). *N,N*-dimethyldecylamine (93.0%, DMDA) was purchased from J&K Scientific Ltd. (Beijing, China). Deionized water was used throughout the experiments (Millipore, Billerica, MA, USA).

Instrumentation

The particles were centrifuged with a Heraeus Multifuge 1S-R centrifuge (Thermo Fisher Scientific, Waltham, MA, USA). The calcination was carried out with a Ceramic Fibre Muffle Furnace (Michem, Beijing, China), with the maximum temperature as 1200 °C. The morphology and microstructure of the as-prepared particles were investigated by means of field emission scanning electron microscopy (5.0 kV, JSM-7800F, Peabody, MA, USA), scanning electron microscopy after sputtering gold layers for 120 s (20 kV SEM, FEI, Eindhoven, Holland), transmission electron microscopy (120kV, JEM-2000EX, Peabody, MA, USA), and nitrogen adsorption-desorption analysis (ASAP 2020, Micromeritics, Norcross, GA, USA). For nitrogen sorption experiments, samples (typically 150 mg dry powder) were outgassed at 350 °C for 10 h under vacuum to remove the adsorbent from the surface, and then nitrogen adsorption-desorption isotherms were obtained through physisorption measurements (nitrogen volume against its relative pressure). Finally, surface area was determined from the isotherms by Brunauer-Emmett-Teller (BET) method. The nanopore diameter was obtained from Barrett-Joyner-Halenda (BJH) method.

Particle preparation

In our experiments, nonporous silica (NPS) particles were prepared according to our previous protocol, [1] and 1 g of the NPS particles were added into the microemulsion system consisted of 100 ml of water, varied amounts (4.5, 2.3 and 0.8 g corresponding to 5.8, 3, 1 mL) of DMDA and 1.0 g of CTAC. Then, 26 mg of ammonium fluoride and 6.0 ml

of ammonia were sequentially added into the solution. The reaction was carried out at 90 °C for 24 h under magnetic stirring. The product was washed with 95% (v/v) ethanol (3 times) and water (2 times) by centrifugation at 2500 rpm in 3 min, dried at 65 °C, and calcined from 25 to 550 °C at a ramp rate of 1 °C min^{-1} with the final temperature kept at 550 °C for 6 h in air.

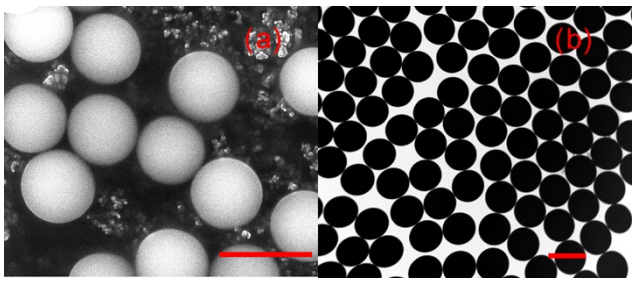

Fig. S1 Electron microscopic images of NPS silica particles.
SEM: (a); TEM: (b). The scale bar is 2 μm.

Preparation of particles from DMHA and CTAC

The dual-template was DMHA and CTAC, and other condition was same as mentioned above (mass ratio of DMHA/CTAC was 4.6).

Preparation of particles from DMDA and CPC

The dual-template was DMDA and CPC, and other condition was same as mentioned above (mass ratio of DMDA/CPC was 4.5).

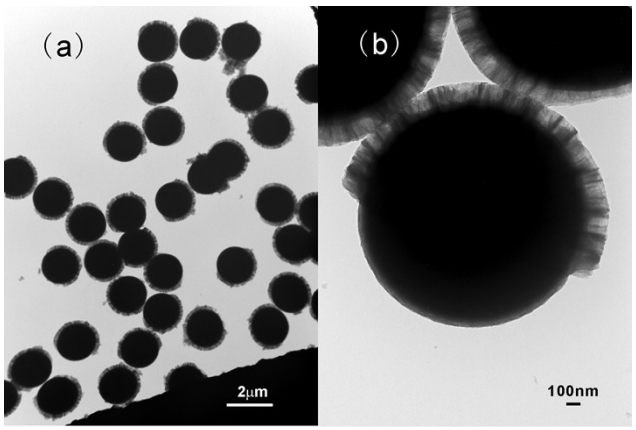

Fig. S2 TEM images of particles prepared by dual-template of DMDA and CPC.

Reference

1 Y. Min, B. Jiang, C. Wu, S. Xia, X. Zhang, Z. Liang, L. Zhang, Y. Zhang, *J. Chromatogr. A,* 2014, **1356**, 148-156.