Supporting Information

Weak Acid-Base Interaction Induced Assembly for the Synthesis of Diverse Hollow Nanospheres

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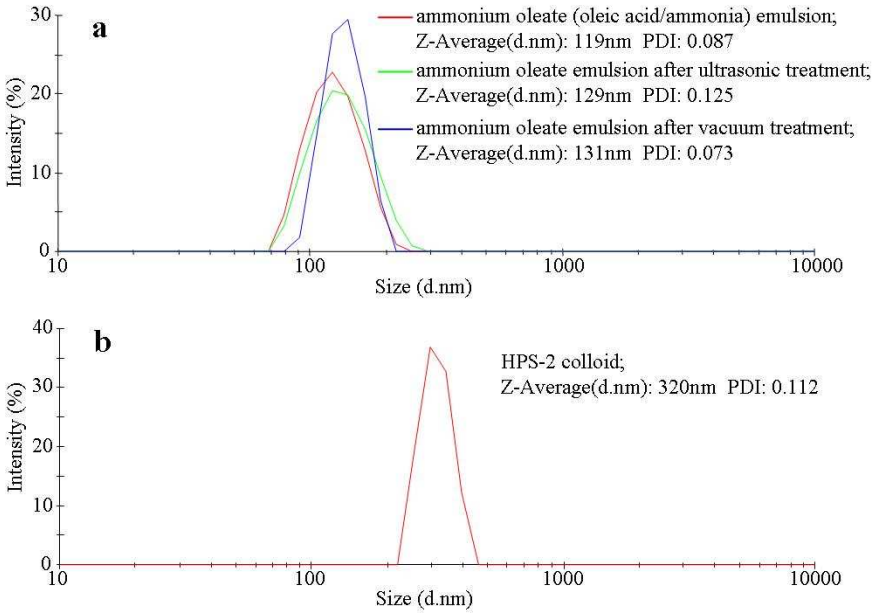

Figure S1. Size distribution of ammonium oleate (oleic acid/ammonia) emulsion before and after ultrasonic (45 KHZ/240 W, 5 min) or vacuum (1~10 mbar, 5 min) treatment (a), HPS-2 (b) measured by dynamic light scattering (DLS).

We further testified the function of the oleic acid emulsion in the synthesis process by DLS measurements. As shown in the Figure S1a, the size distribution of the emulsion droplet is very uniform, with average size of 119 nm. It is noteworthy that there is almost no change in the size and size distribution of the emulsion droplet after ultrasonic and vacuum treatment, demonstrating the stability of the oleic acid emulsion. In addition, a 5-minute evacuation (1~10 mbar) on this emulsion solution did not change the emulsion size, which demonstrates the stability of the ammonium oleate (product from oleic acid and ammonia). After the hydrothermal process, the obtained HPS-2 has an average size of 320 nm with a narrow distribution. This value of the hydrodynamic diameter is larger than that measured by TEM, due to the Brownian movement and the presence of surfactant, the drying effect, etc. Since TEM gives a better direct visibility than DLS, we therefore discuss our results predominantly based on TEM and SEM characterization in this study.

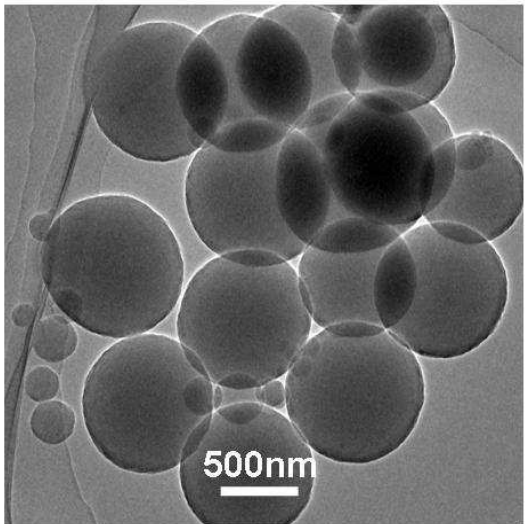

Figure S2. TEM image of solid polymer spheres.

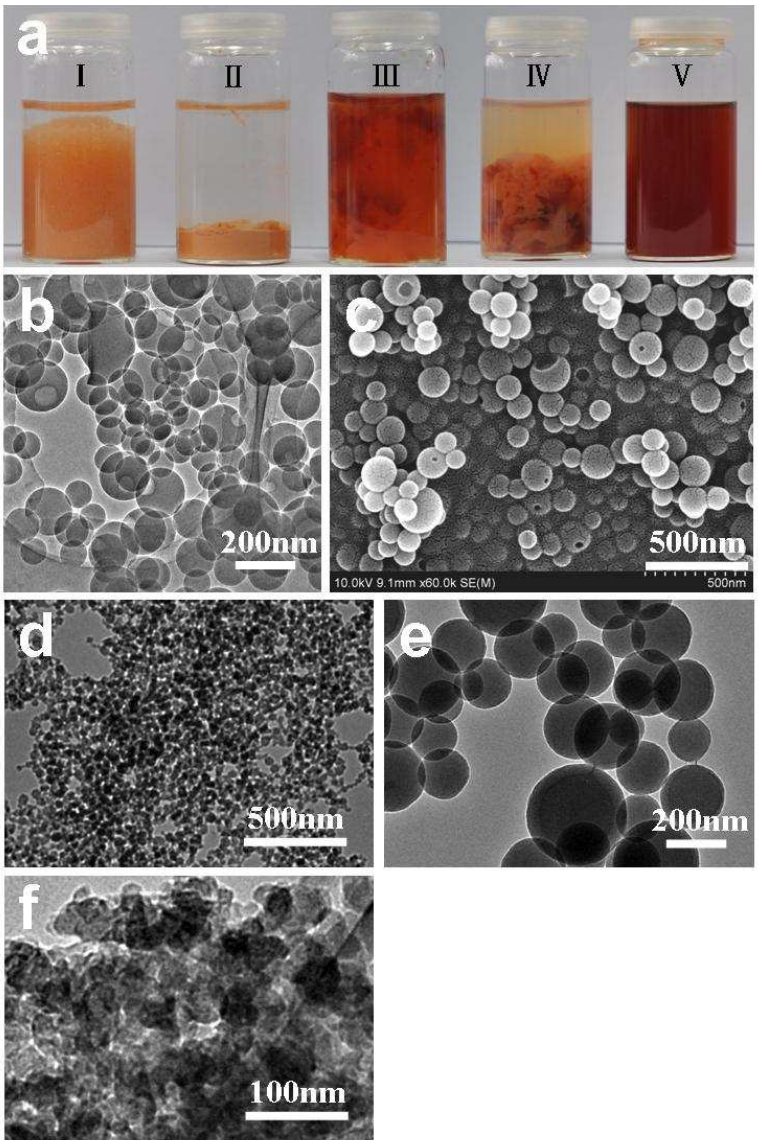

Figure S3. (a) Photographs of the products after hydrothermal synthesis: (I) Pluronic F127 as the surfactant, (II) CTAB as the surfactant, (III) SDBS as the surfactant, (IV) resorcinol as the polymer precursor and (V) NaOH as the catalyst; (b) TEM and (c) SEM images of the polymer spheres prepared using phenol as the polymer precursor; TEM images of the products prepared using (d) F127, (e) CTAB and (f) SDBS as the surfactants. These syntheses are identical to that of HPS-2 but with one variable changed in each case.

Note: Remarkably, the synthesis method can be extended, besides oleic acid and 2, 4-dihydroxybenzoic acid, to use other carboxyl containing surfactants and polymer precursors to prepare hollow nanospheres. Following the synthesis conditions of HPS-2, we have tested other surfactants (e.g. 1, 6-heptadecenoic acid, sodium oleate, linoleic acid, and linolenic acid), and polymer precursors (e.g. 3-(4-hydroxyphenyl) propionic acid and 3, 4-dihydroxybenzoic acid). Representative TEM images of the obtained hollow nanospheres are shown below, Figure S4. Although the obtained products are not very uniform in size, nanospheres with hollow cores can be clearly observed. Hence, the proposed weak acid-base interaction induced assembly mechanism can be regarded as a general mechanism. We believe that the uniformity of the obtained hollow nanospheres can be improved by further optimization of the synthesis conditions.

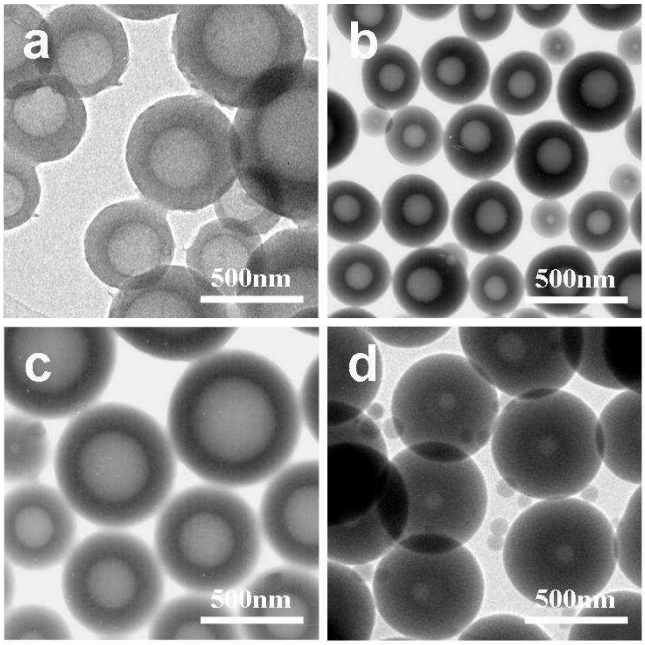

Figure S4. TEM images of (a) oleic acid and 3-(4-hydroxyphenyl) propionic acid, (b) 1, 6-heptadecenoic acid and 2, 4-dihydroxybenzoic acid, (c) sodium oleate and 2, 4-dihydroxybenzoic acid, (d) linoleic acid and 2, 4-dihydroxybenzoic acid.

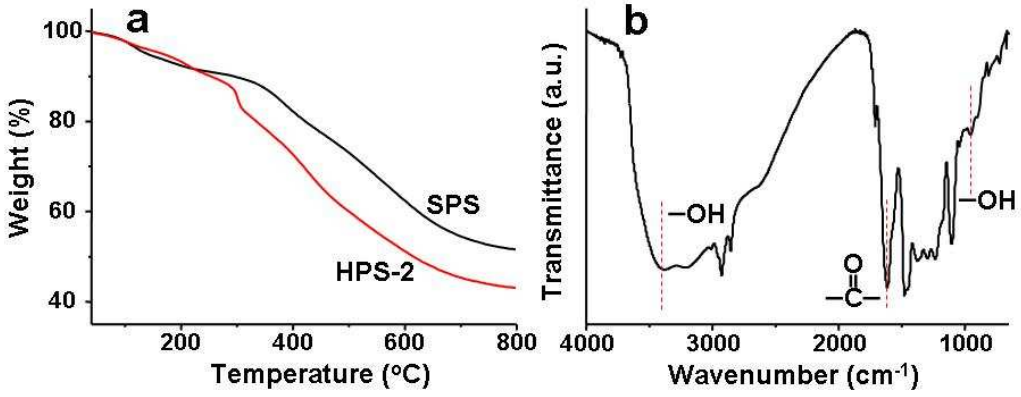

Figure S5. TG curves (a) of HPS-2 and SPS; FT-IR spectrum (b) of the HPS-2.

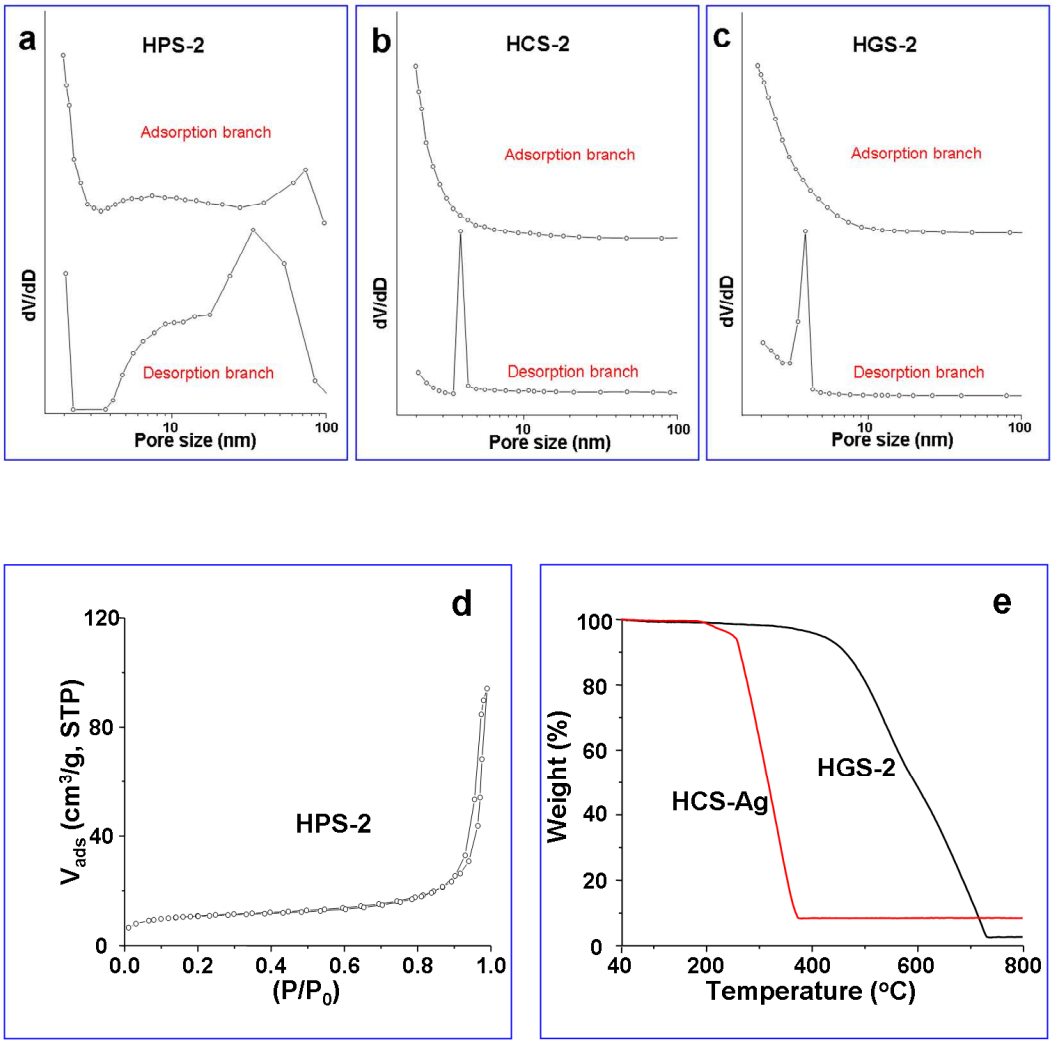

Figure S6. (a–c) Pore size distributions of HPS-2, HCS-2 and HGS-2; N_2 sorption isotherm (d) of HPS-2, TG curves (e) of HGS-2 and HCS-Ag.