Supporting information

Simultaneous Formation of Silica-protected and N-doped TiO_2 Hollow Spheres using Organic-inorganic Silica Nanoparticles as Self-removable Templates

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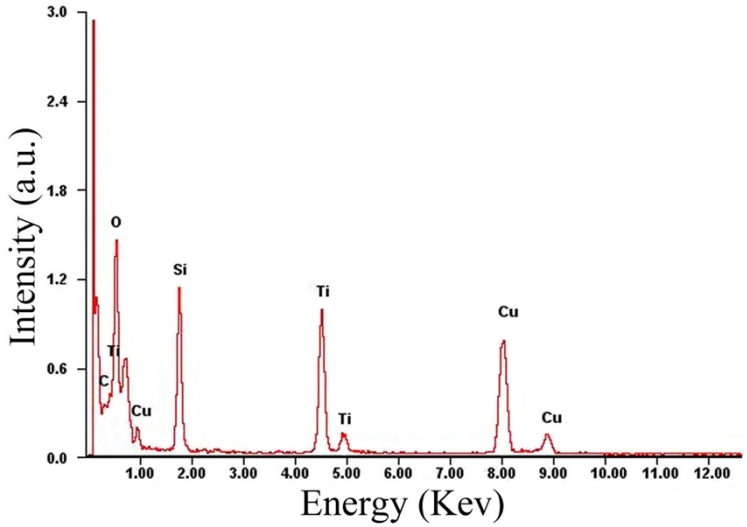

Fig. S1 EDX analysis of the silica-protected TiO_2 HSs. The existence of element Ti, Si and O confirms that the nanocomposites consist of TiO_2 and SiO_2. The Cu signal is from the copper grid.

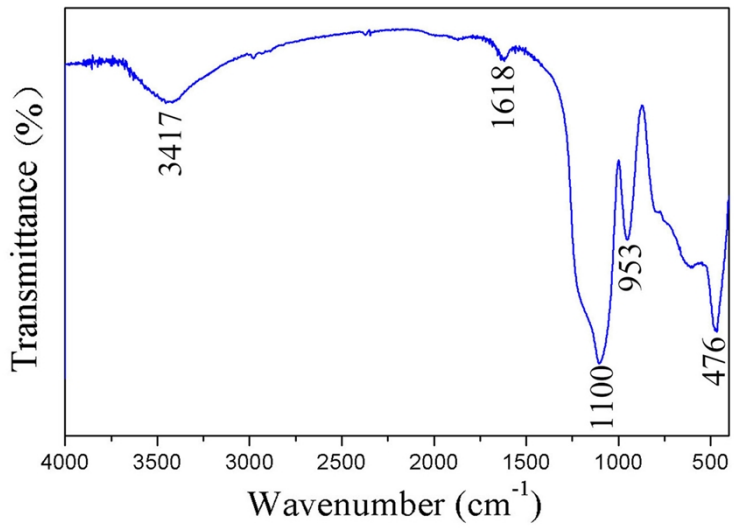

Fig. S2 FTIR spectrum of the prepared TiO_2 HSs. The characteristic peak at 1100 cm^{-1} and 953 cm^{-1} are from Si-O and Si-O-Si bonds. The peaks at 400~700 cm^{-1} are assigned to Ti-O stretching and Ti-O-Ti stretching modes. This date further confirms that the sample consists of SiO_2 and TiO_2.

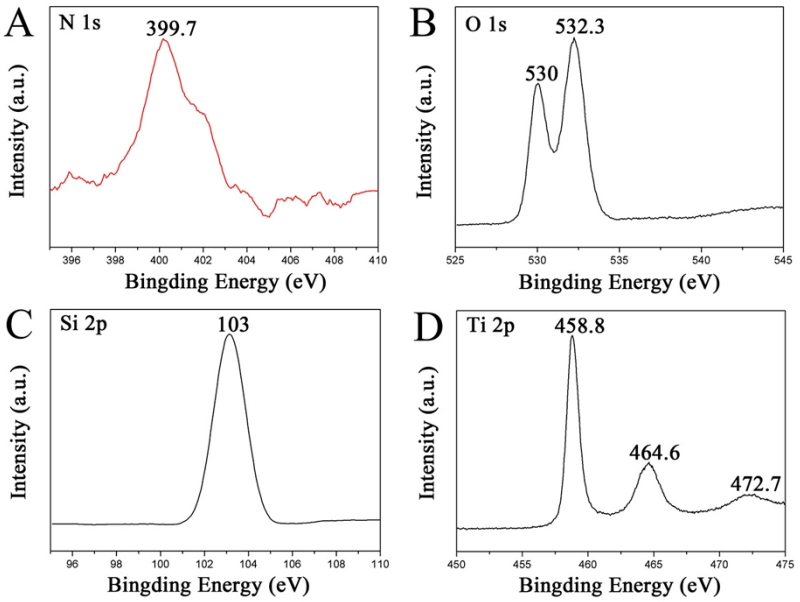

Fig. S3 XPS analyses of the prepared sample after 900 ºC calcinations: (A) N 1s; (B) O 1s; (C) Si 2p; (D) Ti 2p. The existence of element N shows that N has been doped in the sample. These data also confirm that the compositions of sample are N-doped TiO_2 and SiO_2.

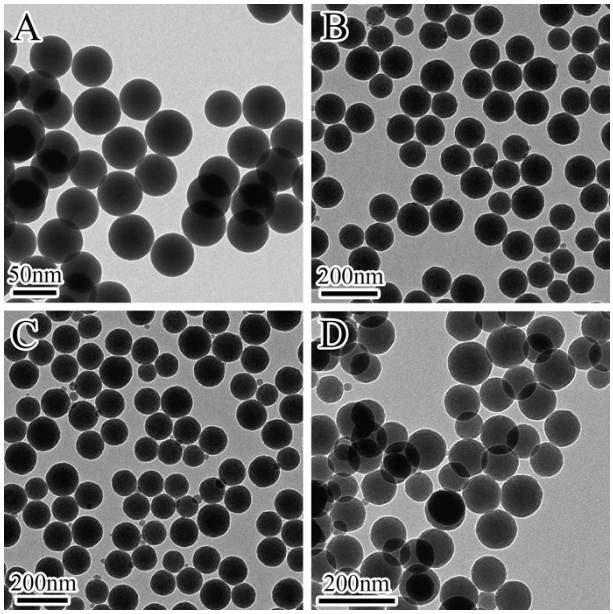

Fig. S4 TEM images of TSD-SiO_2 spheres prepared with different ratios of TSD/TEOS. (A) 1:16; (B) 1:8; (C) 1:4; (D) 1:2. Uniform TSD-SiO_2 spheres can be obtained with various TSD/TEOS ratio.

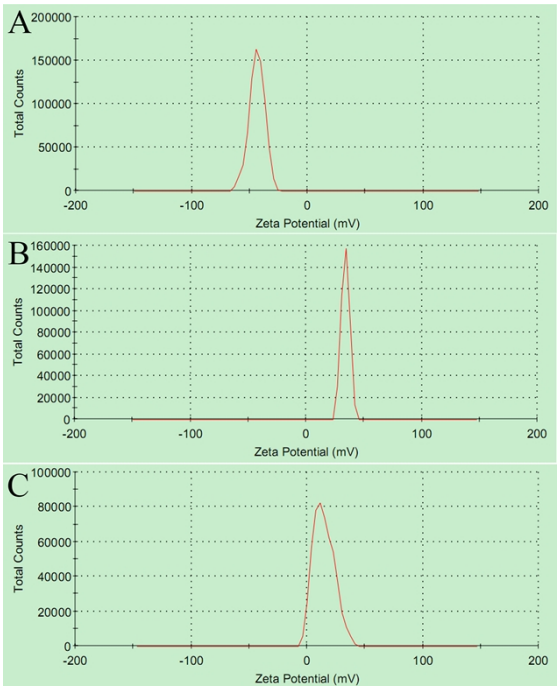

Fig. S5 Zeta potentials of different NPs: (A) pure SiO_2 NPs without TSD; (B) TSD-SiO_2 NPs; (C) SiO_2/TiO_2 HSs before calcinations. When TSD was added in the silica NPs, the TSD-SiO_2 NPs are positively charged. After the etching-deposition process, the formed SiO_2/TiO_2 HSs NPs is still positively charged, indicating that a few TSD molecules were maintained in the particles.

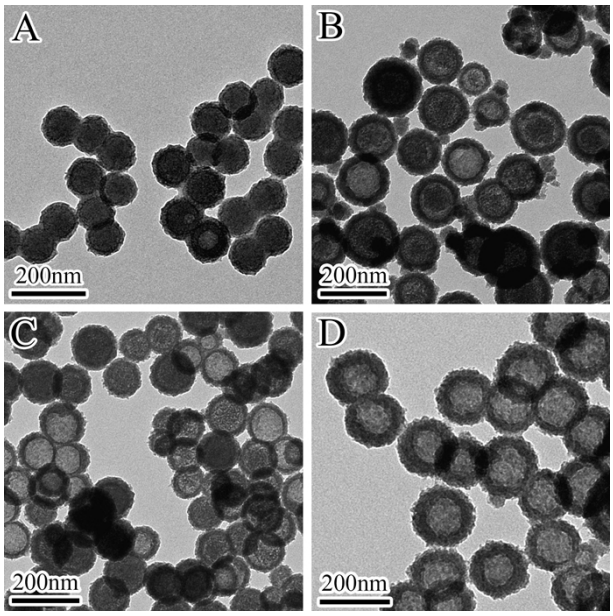

Fig. S5 TEM images of the samples prepared with different TSD-SiO_2 templates of various TSD/TEOS ratio: (A) 1:16; (B) 1:8; (C) 1:4; (D) 1:2. As the increase in TSD content, more and more hollow structures appear in final products. Complete hollow structures can be achieved at a ratio of 1:2 (TSD/SiO_2).

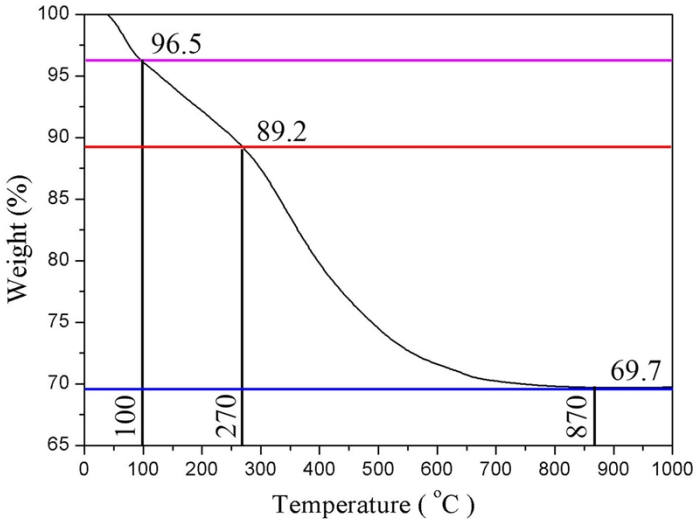

Fig. S6 TGA curves of the amorphous TiO_2 HSs prior to annealing. The first weight loss around 100 °C is due to the removal of adsorbed water (3.5 wt.%). The second weight loss at 100 ºC~270 ºC corresponds to degradation of organic species such as TSD doped in the sample (7.3 wt.%). The third weight loss at 270 ºC~870 ºC is attributed to further degradation of organic species and phase transformation of amorphous TiO_2 to anatase NCs (19.5 wt.%). The total weight loss of sample is 30.3 wt.%.

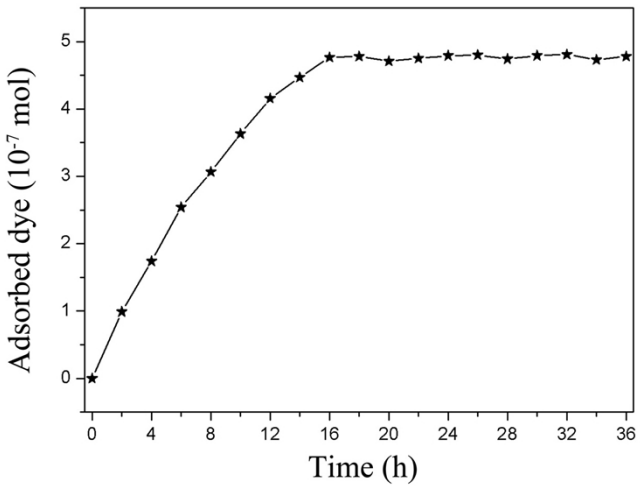

Fig. S7 Adsorption kinetics of RhB solution on the silica-protected TiO_2 HSs. The adsorption-desorption equilibrium reaches at about 16 h, suggesting that the prepared sample can continuously adsorbed small molecules in a prolonging manner due to their porous surface and hollow interior.

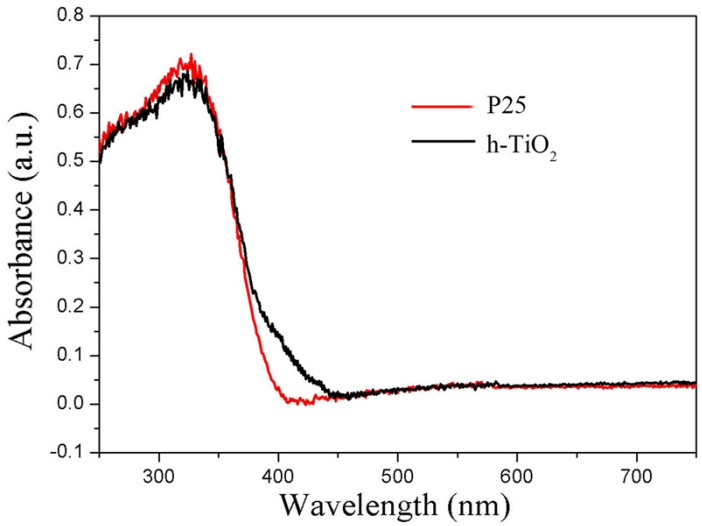

Fig. S8 UV-Vis diffuse reflectance spectra of the prepared TiO_2 HSs and commercial P25.