Silica Micelles (Hydrophilic Core@Amphiprotic Shell) for Multiple Applications

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Abstract

We present the preparation and multiple applications of superhydrophobic hollow SiO_2 micelles (SHSMs) with hydrophilic cores and amphiprotic (superhydrophobic/hydrophilic) shell structures that act as "all-in-one" smart nanomaterials. Our SHSMs are better than hydrophilic@hydrophobic micelles prepared using previously reported methods for several reasons: (i) the polyallylamine hydrochloride (PAH) chains were extended and survived from the core to the shell even after octadecyl-trimethoxysilane (OTMS) treatment, meaning that hydrophilic groups (PAH) exist inside and outside of the SHSMs. In other words, hydrophilic PAH coexists with hydrophobic OTMS outside of the SHSMs. (ii) The SHSMs simultaneously showed hydrophilic (surface charge, +31.27 mV) as well as hydrophobic (superhydrophobicity, CA=163^o) properties due to their unique structures consisting of hydrophilic cores and amphiprotic shells. Therefore, amphiprotic shells and active amine groups made the SHSMs to use as catalysts for hydrophilic and hydrophobic environments. We demonstrate multiple applications of SHSMs: (a) inorganic catalysts for micelle catalytic reactions in organic or aqueous solutions, (b) superhydrophobic coating of sponges or metal meshes for oil/water separation and pollutant purification, and (c) hydrophobic carriers for ultrahigh loading of enzymes with significant stability and efficient recyclability.

References

[1] Md. Shahinul Islam, Won San Choi, Sun Ha Kim, Oc Hee Han, Ha-Jin Lee, Adv. Funct. Mater. **25** (2015) 6061-6070.
[2] Md. Sahinul Islam, Won San Choi, Ha-Jin Lee, ACS Appl. Mater. Interfaces **6** (2014) 9563-9571.
[3] Md. Shahinul Islam, Ha Neul Choi, Won San Choi, Ha-Jin Lee, J. Mater. Chem. B **3** (2015) 1001-1009.

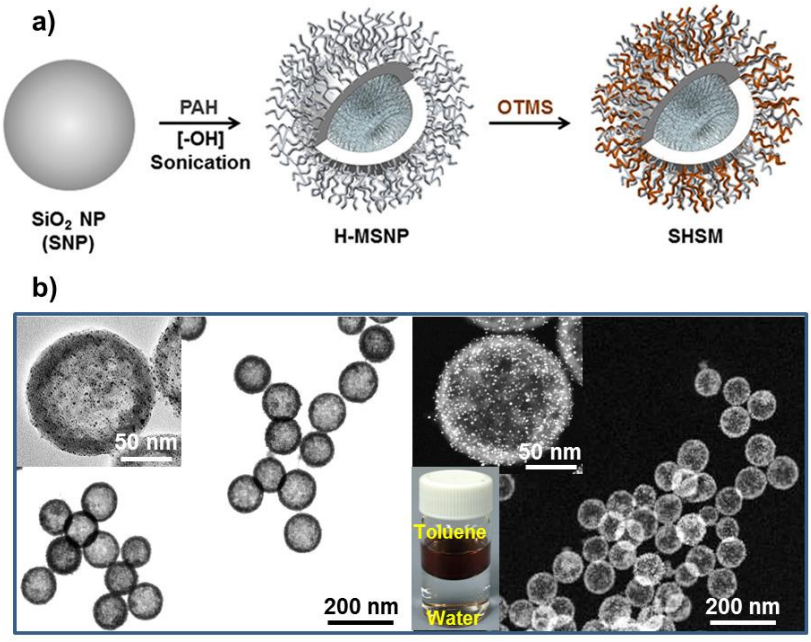

Figure. (a) A schematic representation for the synthesis of silica micelles (Hydrophilic Core @Amphiprotic Shell: SHSM) and (b) UHR-SEM images of the AuNP-embedded SHSM.