

used as template for micron-sized mesoporous silica particles, fluorine atom has larger van der Waal's radius compared to hydrogen, which improves stiffness of FC chains and there is also stronger interchain van der Waal attraction among perfluorinated alkyl chains.

Formation of multilayered silica vesicles with 30–40 nm diameter has been reported using a new technique involving two surfactants called dual templating. Gu et al. (2009) used CTAB and FC-4 as cotemplates and TEOS as silica precursor, whereas Wu et al. (2012) and Xu et al. (2013) utilized cationic surfactants CTAB and sodium dodecyl sulfate (SDS) as SDA. Sun et al. (2016) controlled number of vesicular silica layers by changing molar ratio of DDAB/CTAB. The molar ratio DDAB/CTAB influences structural transition and deciding the number of vesicular silica layers. The average packing parameter (P) of the DDAB/CTAB cosurfactants determines the nature of phase. With increase in P value from 0.33–0.50 to 0.50–1.0 a vesicular phase is formed rather than worm-like (WO) micelle phase. DDAB enhances aqueous solubility, its molecular structure contains two hydrophobic tails, as such increasing DDAB amount increases vesicular interbilayer repulsive forces, consequently decreasing the number of layers of vesicular silica. For reaction performed at 0.832:1 of DDA/CTAB 3–4 layers were formed, which reduced to 2–3 layers at 1.104:1 for vesicular silica.

19.2.3 Rod-Shaped Mesoporous Silica

The shape of mesoporous silica particles is determined by the state of aggregation of micelles, which in turn depends on amphiphilic structure of surfactants. Yu et al. (2011) synthesized rod-like mesoporous silica having dimensions 200–400 nm for different CTAB concentrations. In order to expand the potential application several researchers have modified synthesis of rod-like mesoporous silica by using mixed surfactants. Wu et al., 2011 used a surfactants mixture having *N*-dimethyl-3-ammonio-1-propanesulfonate (DDAPS), *N*-dodecyl-*N* and SDS as templates to synthesize rod-like hollow mesoporous silica particles with ordered mesopores parallel to the axis.

19.2.4 Mesoporous Silica Nanospheres

Zhai et al. (2010) reported use of methylcellulose (MC) and PEG as macropore structure templates. The auxiliary function of PEG and reversible thermosensitive property of MC helped to achieve fast gelation of droplets compared to polymerization reaction. Uniform monodispersed silica spheres were obtained by this new temperature-induced gelation method, however by adjusting MC concentration and temperature silica spheres with different internal structure morphologies were also obtained. PEG has high molecular weight (PEG 20,000), which accelerated gelation, simultaneous addition of suitable amounts of PEG and MC yielded silica particles with smooth outer surface, good dispersability