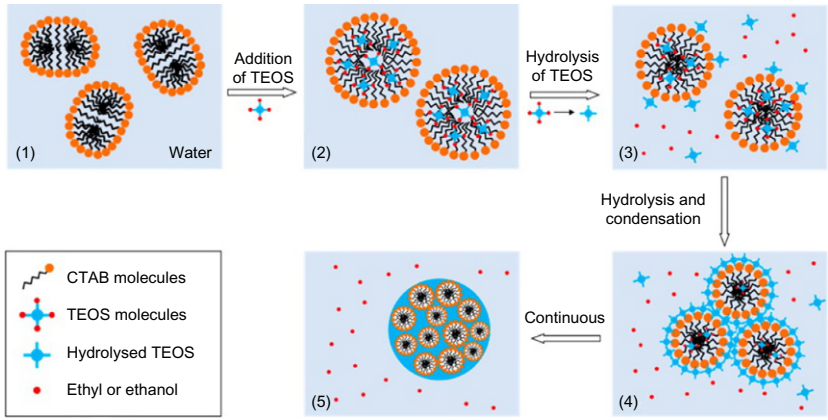

FIG. 19.2 Growth mechanism for mesoporous silica nanoparticles.

recently proposed a new growth mechanism for MSNs using small angle X-ray scattering analysis. Their mechanism as shown in Fig. 19.2 provides fundamental knowledge regarding structural changes at nanometer scale, which gives a deep insight into growth mechanism of MSN (20 nm). The growth kinetics of MSNs indicate increase in size of MSNs at higher temperature and solution pH. The other factor that impacts MSN size is CTAB concentration. Teng et al. studied this effect by varying CTAB concentration for fixed ethanol-to-water ratio. For ethanol-to-water volume ratio of 0.59, MSNs were prepared for CTAB concentration of 5, 10, and 15 mM. Maximum size of MSN 720 nm is reported for 5 mM of CTAB, which decreases to 400 nm at 10 mM, which further reduces to 330 nm at 15 mM. The pore diameter of 3.0 nm is reported for MSNs synthesized at CTAB concentration of 10 and 15 mM according to BIM. The increase in CTAB concentration accelerate the hydrolysis of TEOS, thus dissolving the TEOS droplets and it cannot act as the core template to direct synthesis of hollow silica spheres.

19.2.2 Role of Surfactant

Surfactant micelles assemble into a particular order depending on the conditions prevalent; basically a surfactant is an organic amphoteric molecule consisting of long hydrophobic chain and hydrophilic groups. Tanev et al. (1997) reported vesicle-like mesoporous silica particles having diameter 300–600 nm and pore size 2–2.7 nm. The vesicle-like structure was obtained through assembly of homogenous solutions, TEOS as inorganic precursor and neutral bola amphiphiles $H_2N\,(CH_2)n\,NH_2$ ($n = 12$–22) as structure directors. Generally, hydrocarbon (HC) surfactants are used as templates or cotemplates but now FC surfactants are attracting great deal of attention. They are more surface active and hydrophobic compared to HC surfactants. FC surfactants are also being