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In-situ Small Angle X-ray Scattering Investigation of Formation of Meso-porous Silica Nanoparticles and Swelling-Shrinking Growth Mechanism

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The general explanation of how MSNs grow is that the silica monomers hydrolysed from silica precursor adsorbed onto surfactant micelles and condensed into silica to form particles. However, the detailed growth mechanism of MSNs still remains unknown especially for the MSNs with small particle size. Herein, time-resolved SAXS with a synchrotron source was employed to investigate the growth of MSNs under different experimental conditions. The fitting models were introduced into the system to interpret the SAXS data. The results suggested that the added TEOS inserted into the hydrophobic core of CTAB micelles, forming an emulsion at the beginning of the growth. The silica monomers were hydrolysed from the inside of the micelles into the solvent. The CTAB micelles were actually swelled by the addition of TEOS and with the consumption of the TEOS the pores formed by CTAB was shrunk to form the final meso-pores. To the best of our knowledge, this mechanism is found for the first time, which will highly contribute to the understanding of MSN growth mechanism.

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mesoporous silica nanoparticles, growth mechanism, time-resolved SAXS

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