

Role of inorganic salts in the formation of ordered periodic mesoporous organosilicas (PMOs) without extra acids

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Abstract

The promoting effects of several inorganic salt pairs as NaCl/M(O)Cl_x (M = Zr⁴⁺, Sn⁴⁺, Fe³⁺, Cr³⁺, Al³⁺) on the assembly of periodic mesoporous ethanesilicas templated by copolymer surfactant (EO₂₀PO₇₀EO₂₀, P123) were studied under the conditions where no additional acid was added. The structural properties were thoroughly characterized by small angle X-ray scattering (SAXS), nitrogen sorption isotherms, transmission electron microscopy (TEM), scanning electron microscopy (SEM), ¹³C and ²⁹Si CP MAS NMR, and thermogravimetric analysis (TGA). It was observed that while keeping the NaCl/Si ratio constant highly ordered SBA-15-like ethanesilicas can be easily prepared in the presence of inorganic salt pairs within a wide synthesis range except for the NaCl/AlCl₃ combination. A plausible assembly mechanism based on the favorable effects of both NaCl and MCl_x inorganic salts is discussed, that is, the “salting out” effect and self-generated acidity from both inorganic salts, respectively, are important for the formation of ordered large-pore ethanesilicas under the present synthesis conditions.