508c Pore Expansion in Cationic Fluorinated Surfactant Templated Porous Silica Thin Films through Supercritical Carbon Dioxide Processing

Kaustav Ghosh, Hans-Joachim Lehmler, Stephen E Rankin, and Barbara L Knutson

The effect of processing mesoporous silica thin films with supercritical CO_2 immediately after casting is investigated, with a goal of using the penetration of CO_2 molecules in the tails of CO_2-philic cationic fluorinated surfactant templates to tailor the final pore size. Well-ordered thin films with 2D hexagonal close-packed pore structure are synthesized through the liquid phase co-assembly of a homologous series of perfluoroalkylpyridinium chloride surfactants and an inorganic silica precursor. Hexagonal mesopore structures are obtained for both unprocessed films and CO_2-processed films (69 – 172 bar and 25^oC - 45^oC for 72 hours). XRD and TEM analysis reveal controlled and significant increases in pore size for all CO_2 treated thin films relative to the unprocessed sample with increase of CO_2 pressure.

The degree of pore expansion achieved is hypothesized to be due to solvation of the fluorinated tail by CO_2 molecules and is observed to be directly dependent on the length of the fluorinated tail of the surfactants. Measurements of interfacial tension at the water-CO_2 interface in the presence of the cationic fluorinated surfactants is used to interpret the degree of tail solvation with the length of the fluorinated tail. Pore expansion achieved in this study demonstrate the ability to control the pore size in ordered mesoporous silica thin films by combining the tunable solvent strength of compressed and supercritical CO_2 and the design of 'CO_2-philic' fluorinated surfactants.