New opportunities in the synthesis of ultra-large-pore ordered mesoporous materials

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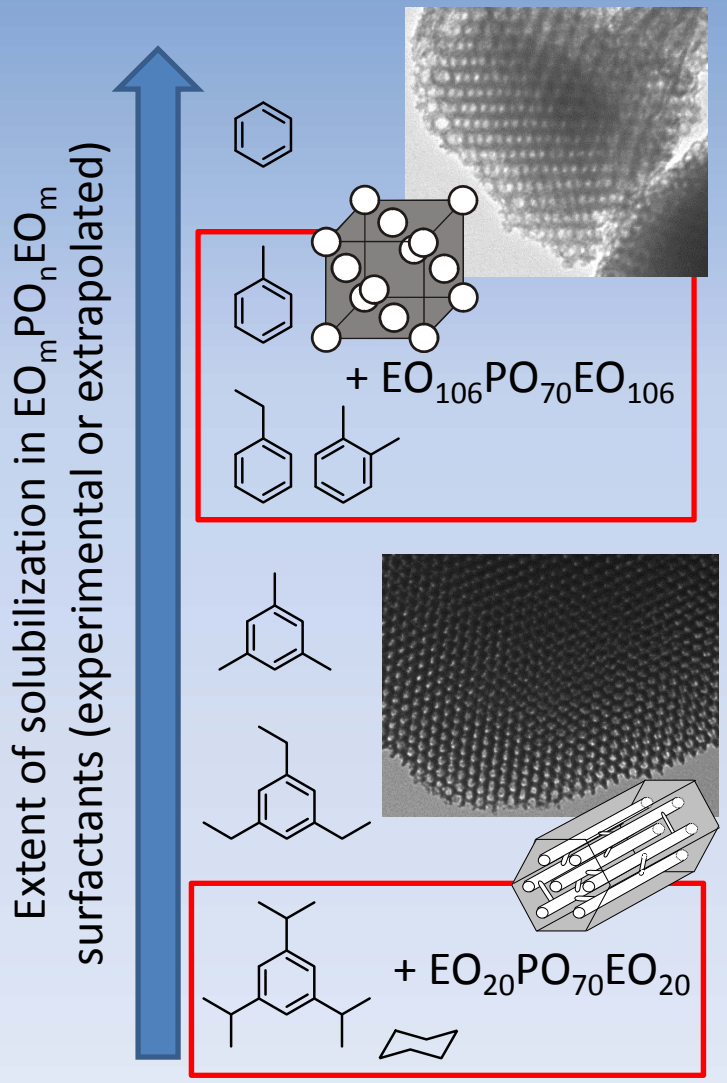

A predictive pathway toward the selection of micelle swelling agents for the synthesis of surfactant-templated ultra-large-pore mesoporous materials was explored. The selection is based on a hypothesis that moderate swelling of surfactant micelles facilitates the formation of well-ordered materials with significantly enlarged mesopores. Experimental data on extent of solubilization of substances in micelles (or their extrapolation within families of compounds) are used to identify swelling agent candidates. 1,3,5-triisopropylbenzene and cyclohexane were identified as “weak” swelling agents for 2-D hexagonal materials templated by Pluronic P123 ($EO_{20}PO_{70}EO_{20}$) with large fraction of the hydrophobic block (which can be readily swollen), and indeed ordered silicas and organosilicas with unprecedented unit-cell sizes and pore diameters were formed. On the other hand, in the case of Pluronic F127 ($EO_{106}PO_{70}EO_{106}$) with much smaller fraction of the hydrophobic block, “strong” swelling agents (xylenes, ethylbenzene or toluene) were found suitable for the synthesis of face-centered cubic silicas and organosilicas with exceptionally large unit-cell sizes and pore diameters. The work demonstrates a powerful method to synthesize porous materials with unprecedented properties.