Evaporation-Induced Self-Assembly of Porous and Composite Thin film Nanostructures
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Nature combines hard and soft materials often in hierarchical architectures to get synergistic, optimized properties and combinations of properties with proven, complex functionalities. Emulating such natural material designs in robust engineering materials using efficient processing approaches amenable to manufacturing represents a fundamental challenge to materials scientists and engineers. Currently there is considerable interest in evaporation-driven self-assembly as a means to create porous and composite thin film nanostructures using simple commercial procedures like dip or spin-coating and ink-jet printing. This presentation will first review recent progress on evaporation-induced silica/surfactant self-assembly (EISA) to prepare porous thin film nanostructures of interest for membranes, sensors, and low K dielectrics. Starting with a homogenous solution of surfactant plus hydrophilic silica precursors, solvent evaporation concentrates the depositing film in precursors and surfactant inducing micelle self-assembly and further self-organization into thin film silica/surfactant mesophases. Exploiting the steady, continuous nature of dip-coating, it is possible to spatially resolve the complete evaporation-induced self-assembly pathway and interrogate it using spectroscopy and/or grazing incidence SAXS. I will then discuss surfactant self-assembly as a means to organize simultaneously hydrophilic and hydrophobic precursors and even living cells into hybrid responsive nanocomposites that are optically or chemically or metabolically polymerizable, patternable, or adjustable.