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Different ordered materials prepared by interface-selective sol-gel polymerization

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Sol-gel reaction in aqueous solutions is one of the most useful methods to coat small complex templates with inorganic materials and has been applied to fabricating discrete inorganic and hybrid materials that were replica of the templates. Selective gel formation at the interface between templates and water is highly desired to obtain discrete materials and there have been two distinctive approaches to accomplish interface selective sol-gel reactions; confining inorganic precursors to interfaces[1,2] and guiding sol-gel reaction by attractive electrostatic interactions between templates and gel-forming species.[3-10] Confining silica precursors to interfaces was partially successful as only large spherical silica materials were obtained[1] or only monolithic silica materials were obtained.[2] Attractive interactions were introduced in fabricating discrete silica materials mainly by carrying out reactions at pH's higher than the isoelectric point (ISP) of silica using positively charged templates such as tobacco mosaic virus,[3] positively charged gel fibers,[4, 5] vesicles of positively charged lipids,[6,7] polystyrene latex particles, filamentous crystals[9] and collagen fiber.[10] Monolithic materials were obtained when non-positively charged materials such as microemulsions,[11-13] non-positively charged gel fibers,[5,10] bacterial super structures,[14] and arrays of living yeast cells[15] were used as templates. These previous works showed that only organic materials that meet certain requirements could be used as templates to fabricate discrete materials. We are describing results showing that restrictions on choosing templates could be largely relieved when amphiphilic self-hydrolyzing tetrakis[2-(2-methoxyethoxy)ethoxy]silane (TMEES) and tetrakis(2-methoxyethoxy)silane (TMES) were used as silica precursors. Also, other amphiphilic precursors of titania, alumina, and iron(III) oxide gave similar results. We are describing mainly about fabricating silica materials in this report.