Liquid molding for the synthesis of silica aerogels

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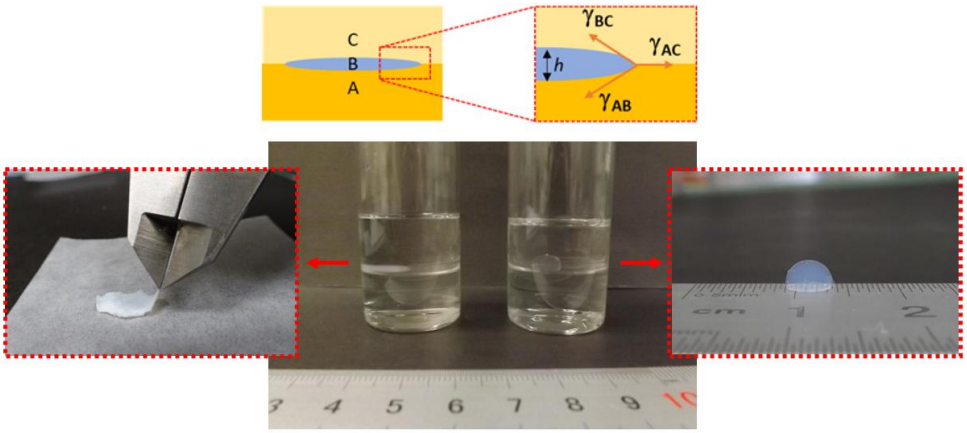
Silica aerogels are porous materials with porosity exceeding 90% and very low density (<200 mg·cm^{-3}). These characteristics make them the most effective solid thermal insulators. Of those, aerogel films are best suited for thermal insulation in microsystems. To achieve sufficient insulation, films in the range of a few microns and up to several hundred microns are required. However, spin coating and dip coating, which are currently used to synthesize aerogel films, are restricted to thicknesses smaller than 2 µm. To circumvent the present limitations, we propose to use liquid molding as a means to produce aerogel films thicker than 2 µm in a single molding step. Liquid molds are made of two immiscible liquids: a liquid substrate and a liquid cover, each with a suitable density to form a layered structure with silica sol prior to polymerization. Gelation of the sol occurs while it is surrounded by the liquids. Thus, solvent evaporation from the outer surface of the gel once it is formed is avoided, and smooth surfaces are formed. Following gelation and aging, the gels can be removed from the liquids and dried under supercritical conditions with carbon dioxide. The dry films produced are free-standing and can be implemented in various systems. The surface tension between the liquids determines the aerogel film thickness. In the presentation two model systems will be shown to demonstrate fabrication of silica aerogels of different thicknesses (4 mm and 130 µm). The resemblance of the liquid mold approach to the float glass technique offers the prospect of mass production of large sheets of aerogel films.



Two sets of liquids were used to produce silica aerogels with different thicknesses.