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Abstract Formulary

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Title: Surfactant-free synthesis of methyl functionalized silica gels with tuneable micro-structures

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ABSTRACT (Space limited to 2200 characters)

Highly porous silica gels can be synthesized through the sol-gel processes and their microstructures (pore/particle sizes) are tuneable from several nanometers to hundred micrometers. However, such variable structures cannot be achieved by one general approach.[1,2] Recently, a surfactant-assisted protocol was reported [3], who provided a feasible route for varying the silica gel structures by using di- and tri- functional alkoxysilanes co-precursors. However, this method requires a long aging period to guarantee a good gel formation and the use of large amounts of surfactants and the gelation trigger urea, which needs to be removed after gel formation by intensive solvent exchanges. [4] Herein, we use a surfactant-free protocol to achieve similar structures and properties and reduce the processing time from 7-10 to 2 days.[5] The pore and particle structure are controlled by the proportions of the di- and tri-functional alkoxysilanes and their gelation solvents. The gel structures were found to be strongly influenced by the solvents with different Hansen solubility parameters[6], the average pore sizes can be varied from 20 nm to 10 µm, and the surface area could be tuned from over 500 $m^2 g^{-1}$ to below 0.5 m^2g^{-1}, while all samples maintain a similar high porosity and low envelope density. All the samples show comparable water repellency with contact angle close to 150°, which is efficient for oil absorption in water. The gels with large particle sizes (6 µm) present superior acoustic properties, especially in the low frequency ranges, and the change in the pore size affects such sound absorption frequency ranges and effectiveness. The work provides a simple and scalable method to achieve various pore structures from one single sol-gel formulation. A fundamental understanding of pore structure formation as a function of solvent system was systematically studied. The materials with specific pores show high potential for various applications in oil-water separation and acoustic absorption.

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