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Title: Structure vs mechanical properties of MTMS-based aerogel

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ABSTRACT (Space limited to 2200 characters)

Due to outstanding thermal and acoustic insulation properties, low density resulting in high porosity and well developed specific surface area, the commonness of aerogel application continuously increases. Nonetheless, their unsatisfactory mechanical properties and fragility are still a significant objection to universal aerogel applicability. The improvement of this aspect would be a huge step towards further commercialization. The mechanical resistance of aerogels strongly depends on their microstructure, which can be controlled and modified according to the chosen precursors, the chemical composition of the samples, synthesis and drying parameters.

The methyltrimethoxysilane(MTMS) gels synthesis is based on the two-step acid-base method. With increasing volume of aqueous catalyst solutions, the rate of hydrolysis and condensation reactions is accelerated. In this way, it is possible to adjust both the morphology and the properties of gels, and consequently, the aerogels. Structure preservation, understood as volume shrinkage, is investigated both for Ambient Pressure (APD) and Supercritical Drying (SCD). The condensation kinetics (via UV-VIS spectroscopy), morphology characterization (SEM, pycnometry, gas sorption) and uniaxial compression test are performed to determine the structure-mechanical properties relation of investigated gels.

The global connections between the chemical composition of the reaction mixture, the character and mechanism of the condensation process, the obtained microstructure and the mechanical properties of the received dry gels are described. Along with the increase in the proportion of aqueous catalyst solutions, a huge change in the mechanical nature of aerogels, from rigid to elastic, is observed, according to structure change from mesoporous via co-continous to a particle-aggregated macroporous aerogels. However, the highest strength was observed for co-continous aerogels. The comparison of drying methods shows that low capillary forces caused by larger pore size allow for APD application without losing the aerogel properties.

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