New aerogel-like materials: lightweight and mesoporous cellulose xerogels

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Cellulose is a versatile raw material that can be used and shaped in multiple ways depending on the targeted applications. Recently, cellulose was used to produce a new generation of porous materials: the aerogels. In the past decades, these cellulose-based, and more widely, bio-based aerogels, were extensively studied and showed high porosity (> 90 %), high specific surface area (200 – 500 $m^2.g^{-1}$) and low density (around 0.1 $g.cm^{-3}$). Up to now, these outstanding properties were reached thanks to drying with supercritical CO_2. During this drying, the capillary pressure that would lead to the collapse of the gel pore walls is theoretically zero, and the structure is kept intact. Despite the remarkable aerogels' properties, this drying is time consuming, it uses a lot of CO_2 and it is rather expensive.

In this study, we have demonstrated that, by using selected preparation parameters, we can obviate the CO_2 supercritical drying and prepare highly porous, lightweight cellulose "xerogels" with high specific surface area.

Cellulose xerogels were prepared from microcrystalline cellulose via dissolution-solvent exchange and vacuum drying. The influence of cellulose solvent, additives and their concentration, solution gelation or not and the type of non-solvent was studied and correlated with xerogels' properties. The xerogels' density varied from 0.14 to 1.12 $g.cm^{-3}$, their specific surface area was comparable with that of aerogels: up to 300 $m^2.g^{-1}$. The xerogels' properties were compared to those of their aerogels counterparts' and the use of supercritical CO2 for the drying was proven not to be necessary to obtain cellulose aerogel-like materials.

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