New aerogel-like materials: lightweight and mesoporous cellulose xerogels

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Keywords:
Cellulose, Xerogels, Mesoporous, Low density

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 m²·g⁻¹) and low density (around 0.1 g·cm⁻³). Up to now, these outstanding properties were reached thanks to drying with supercritical CO₂. 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 CO₂ and it is rather expensive.

In this study, we have demonstrated that, by using selected preparation parameters, we can obviate the CO₂ 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 m²·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.

Acknowledgements:
This project has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No 685648.