Monolithic Carbon Spherogels Based on Sustainable Precursors

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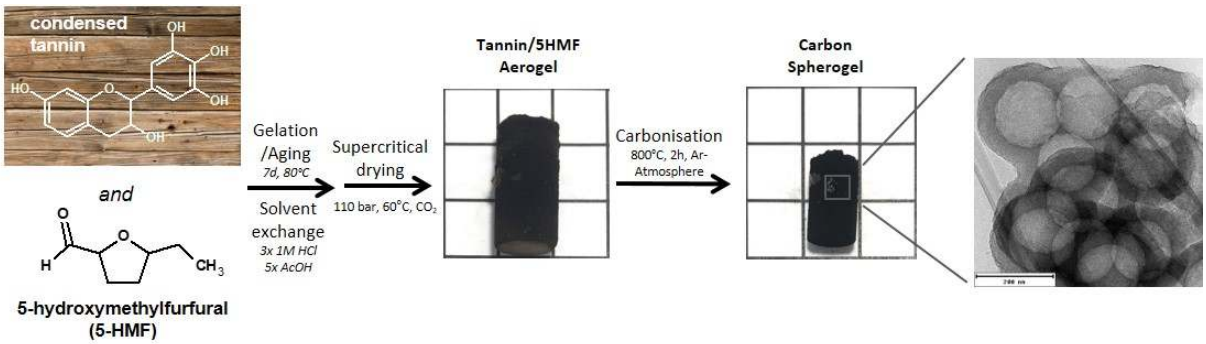
Carbon aerogels, which are generated after pyrolysis of organic aerogels in inert atmosphere, are of increased interest for various applications, such as electrodes for supercapacitors or batteries, as well as in catalysis, due to their excellent material properties, namely low density, high surface area, good mechanical properties, well-adjustable porosity as well as high electrical conductivity. Furthermore, hollow carbon spheres provoked increased interest regarding their, compared to conventional carbon aerogels, additional characteristic properties such as a high surface-to-volume ratio, high structural stability as well as feasibility for encapsulation. However, so far solely hollow carbon spheres powders have been prepared. Salihovic *et al.*[1] were the first to generate freestanding monolithic carbon sphere assemblies by templating with PS latexes, which they term carbon spherogels. Moreover, it has to be addressed that the polymer source for the preparation of carbon aerogels or hollow carbon spheres is often based on the organic precursors, e.g. resorcinol-formaldehyde (R/F), which are toxic and environmentally-harmful. In order to produce hollow carbon spheres from sustainable carbon sources, research has been done to some extent, whereby the capability of monosaccharides as well as carbohydrates to function as organic precursor for hollow carbon spheres was verified. Furthermore, looking back at carbon aerogels, Celzard and Pizzi *et al.*[2] demonstrated the feasibility of replacing resorcinol-formaldehyde by tannin-formaldehyde, which is based on the natural, inexpensive tree extract tannin.

Within this work, we like to present a perspective route to generate freestanding, sustainable, monolithic carbon sphereogels, on the basis of the tree extract mimosa tannin and biomass-derived 5-(hydroxymethyl)furfural (5-HMF), as a crosslinker. Highly porous, homogenous carbon spherogels based on these green organic precursors have been prepared and are investigated regarding their properties in comparison to previously prepared R/F-derived carbon spherogels. Thus, the synthesised materials are thoroughly investigated for their chemical, physical as well as electrochemical properties.



References:

1. Salihovic, M. *et al.* Reversibly compressible and freestanding monolithic carbon spherogels. *Carbon* **153**, 189–195 (2019).
2. Szczurek, A., Amaral-Labat, G., Fierro, V., Pizzi, A. & Celzard, A. The use of tannin to prepare carbon gels. Part I. Carbon aerogels. *Carbon* **49**, 2785–2794 (2011).