From hydrophilic to hydrophobic: Pectin aerogels for thermal insulation applications

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Aerogels are solid materials with nanometer-scale pores showing interesting properties (e.g., high porosity, low density, and high specific surface area) for a range of applications. The field of aerogels based on natural resources, such as polysaccharides, is gaining more and more attention due to the need for sustainable alternatives to conventional, non-renewable counterparts. Among bio-based aerogels, pectin aerogels possess a density of around 0.1 g/cm^3 and a very fine network with meso- and small macropores.
Thanks to these properties, the thermal conductivity of pectin aerogels is below that of air making these materials perfect candidates for thermal insulation applications. However, pectin aerogels are highly hygroscopic: they adsorb moisture from the air leading to network collapse and loss of the initial properties. In this work, various approaches for pectin modification were used to tune the wettability of the aerogels. Pectin was chemically modified using different hydrophobizing agents and reaction conditions. Chemical vapor phase deposition as a more environmentally friendly process was also applied, targeting hydrophobization without the use of solvents. All modified pectin aerogels were hydrophobic with water contact angles in the range of 95 – 128°, highly porous (>90%), and possessed low density and high specific surface area. The effect of hydrophobization on the thermal conductivity was evaluated and the evolution of aerogel properties in time as a function of humidity was recorded.

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