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Abstract Formulary

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Title: Cellulose Ether Aerogels for Thermal Insulation

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ABSTRACT (Space limited to 2200 characters)

Organic aerogels based on polysaccharides such as cellulose aerogels are attracting increased attention for thermal insulation applications due to their sustainability, biodegradability and abundance. However, the insolubility of cellulose in water due to its extensive intra- and inter-molecular hydrogen bonding makes the production of cellulose hydrogels, and therefore aerogels, challenging. Alternatively, cellulose ethers might be used to synthesize cellulose-based bio-aerogels due to their high solubility in water. Here, our aim was to synthesize novel cellulose-ether based aerogels via the freeze-thaw method. The effects of freezing time, the number of freeze-thaw cycles, chemical structure of the precursors and concentration of crosslinking agents on the physical properties of gels such as pore size, pore structure, specific surface area were investigated. Three different bio-based cellulose-ether aerogels were synthesized via using three different cellulose ethers which are sodium carboxymethylcellulose (NaCMC), hydroxyethylcellulose (HEC) and hydroxypropyl methylcellulose (HPMC). Citric acid monohydrate, maleic anhydride and oxalic acid dihydrate were used as crosslinking agents. In a typical synthesis, a certain amount of cellulose ether was dissolved in water at room temperature. Subsequently, a cross-linking agent was added to this solution which was then subjected to freeze-thaw cycles during which the solutions were kept at -18 °C for 2-5 hrs before thawing at room temperature. After that, the resulting gels were dried by supercritical CO_2 in an Applied Separations Speed SFE at 50 °C and 85 bars. Cellulose-ether based aerogels were thus successfully obtained and FTIR results showed that crosslinking was achieved. Aerogels had macroporous structure and the highest BET surface area was measured as 270 m^2/g. The porosities of aerogels were approximately 96% and densities were between 0.05 and 0.08 g/cm^3 which is quite lower than most of the already synthesized cellulose aerogels in the literature. The thermal conductivities of the aerogels were also measured.