Cellulose-[DBNH][CO_2Et] rheological properties and aerogel beads made with JetCutting technique

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Introduction

A new generation of aerogels, based on polysaccharides, have emerged at the beginning of the 21st century. They are porous materials with open porosity, lightweight (density < 0.2 $g.cm^{-3}$) and with high specific surface area (up to 500 $m^2.g^{-1}$). Such aerogels can be used in adsorption and/or separation, as matrices for controlled drug release and for catalysis.

Cellulose II aerogels are prepared via dissolution-coagulation-drying with supercritical (sc) CO_2 and are usually made in the form of monoliths. To decrease the duration of aerogels' preparation (many steps are diffusion-controlled) and for certain applications, aerogels in the form of small particles are needed.

Objectives

We used 1,5-diazabicyclo[4.3.0]non-5-ene propionate, [DBNH][CO_2Et], to dissolve cellulose. The goal was to correlate solutions' rheological properties with the shape and internal morphology of aerogel beads.

Materials and methods

Microcrystalline cellulose was from Sigma Aldrich. 1,5-diazabicyclo[4.3.0]non-5-ene (DBN) was from Fluorochem, and propionic acid [CO_2Et] and absolute ethanol were from Fisher Scientific.

The rheological properties of cellulose solutions were studied using Bohlin Gemini rheometer.

Cellulose beads were prepared with a JetCutter device from GeniaLab, Germany.

Results

First, the rheological properties of cellulose-[DBNH][CO_2Et] solutions were studied in details. Cellulose concentration and solution temperature were varied and visco-elastic properties in dynamic and steady state investigated. Cellulose intrinsic viscosity was determined and compared with the values known for cellulose in other ionic liquids.

Different JetCutter settings allowed varying the beads' size, from 0.5 to 2 mm. Cellulose beads were washed several times with ethanol before drying with sc CO_2. Aerogels' density, specific surface area and morphology will be presented and discussed.

Conclusions

The visco-elastic and hydrodynamic properties of cellulose-[DBNH][CO_2Et] solutions were investigated. Cellulose aerogel beads with tailored sizes were successfully prepared from these solutions using JetCutting technique.

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