PSL UNIVERSITÉ PARIS

THÈSE DE DOCTORAT
DE L'UNIVERSITÉ PSL

Préparée à MINES ParisTech

Cellulose based aerogels: properties and shaping as beads

Defended by:

Lucile Druel

10th of May, 2019

Department:

Mechanic, numeric and Materials

Thesis committee:

Irina Smirnova Professor, Hamburg University of Technology	*Opponent*
Herbert Sixta Professor, Aalto University	*Opponent*
Lennart Salmén Professor, RISE Innventia AB – KTH Royal Institute of Technology	*Examiner*
Yves Grohens Professeur des universités, Université Bretagne Sud	*Examiner*
Tatiana Budtova Directeur de recherche, Cemef – Mines ParisTech	*Supervisor*

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Abstract

Aerogels are ultra-porous and nanostructured materials with a wide range of applications. Bio-aerogels is a new generation of polysaccharide-based aerogels. These fast developing materials are particularly promising for their environmental friendliness and biocompatibility. Nowadays, the production of bio-aerogels in the form of monoliths is mastered. To optimize their manufacturing process and to meet specific application needs (pharmaceutical, food, absorption or adsorption, etc.), aerogels must be in the form of particles.

This work focused on the preparation and characterization of cellulose aerogel beads and was conducted in the framework of the European project "Nanohybrids". Two main objectives were achieved. The first was the preparation and understanding of the properties of new materials while reducing their production costs. Two types of porous materials were produced and studied:

- Cellulose-based xerogels (obviating drying under supercritical CO_2), with properties comparable to those of their aerogel counterparts (density around 0.12 g cm^{-3} and specific surface area up to 300 m^2 g^{-1}).
- Pulp-based aerogels. The influence of each pulp component (cellulose, hemicellulose, lignin) and their content on the structure and properties of aerogels was assessed.

The second objective was the development of methods for shaping cellulose aerogels into beads of different sizes. Two techniques were successfully applied:

- JetCutting: aerogel beads based on cellulose and pulps, varying in size from hundreds of micrometres to a few millimetres, dissolved in two types of solvents (NaOH-water and ionic liquids) were obtained.
- Emulsification: cellulose aerogel particles of about few tens of micrometres were prepared by the development of a new method of emulsification-coagulation.

Keywords

Bio-aerogels. Cellulose. Porosity. Particles.

Funding

This thesis was conducted in the framework of Nanohybrids project.
This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement No 685648. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.