PDF-Export

Topic:

Nano-technology, Micro- & Nano-celluloses, and their applications. Composites and Nano-composite materials

Paper-ID	63271
Paper title	Acetylated microfibrillated cellulose: A reinforcing agent with novel applications
Presentation format	Oral presentation
Date of submission	30.01.2017 23:48 Uhr

Authors

- Alex Berg *(a.berg@udt.cl)* (Presenter)
- Nabin Kumar Karna *(n.karna@udt.cl)*
- Juan Cea *(j.cea@udt.cl)*
- Fabian Parra *(f.parra@udt.cl)*

Content

An interesting bulk product of the future is micro-fibrillated cellulose (MFC) which has been extensively studied for the last few decades. One of the most important applications of MFC is as reinforcing agent of matrices like paper, adhesives, coatings and thermoplastic materials. Unfortunately, in many of these cases the surface characteristics, in particular the polarity of the MFCs, differ strongly from those of the matrix of interest, whereby a suitable dispersion is not possible and, consequently, the reinforcing action does not occur.

In this context, chemical pretreatments aimed at surface modifications to loosen the attractive forces between the cellulose fibrils by preventing the formation of strong interfibril hydrogen bond and aligning the microfibrils in water by repulsive forces generated by ionization of the surface groups seem to provide interesting options to produce evenly dispersed cellulose nanofibrils in water at low process energy cost. In this study, we report surface acetylation of pulp to produce homogeneously dispersed MFC. In fact, the acetylation reaction has been known for more than a century now and serves as the base for the production of cellulose acetate. It is known that acetylation occurs at the surface of the fibers and a homogeneous acetylation is diffucult to achieve. We study the bleached Kraft eucalyptus pulp,varying degrees of fibrillation and acetylation.

The MFCs used in this study was microfibrillated in a pilot plant that consists of a rotary defibrillator of 12 inches of diameter in Technology Development Unit (UDT) of the University of Concepcion. We analyze the energy consumption and the properties of the obtained material. Subsequently, acetylation homogeneity is determined and its inclusion as a reinforcing agent in a paper formulation, an adhesive resin and a polyolefin has been evaluated. We also report the distribution of the reinforcing agent in the matrices and the mechanical properties of the obtained composite materials.

Paper-ID	63296
Paper title	Acetylated microfibrillated cellulose: A reinforcing agent with novel applications
Presentation format	Oral presentation
Date of submission	30.01.2017 23:49 Uhr
Authors	- Alex Berg *(a.berg@udt.cl)* (Presenter) - Nabin Kumar Karna *(n.karna@udt.cl)* - Juan Cea *(j.cea@udt.cl)* - Fabian Parra *(f.parra@udt.cl)*

Content

An interesting bulk product of the future is micro-fibrillated cellulose (MFC) which has been extensively studied for the last few decades. One of the most important applications of MFC is as reinforcing agent of matrices like paper, adhesives, coatings and thermoplastic materials. Unfortunately, in many of these cases the surface characteristics, in particular the polarity of the MFCs, differ strongly from those of the matrix of interest, whereby a suitable dispersion is not possible and, consequently, the reinforcing action does not occur.

In this context, chemical pretreatments aimed at surface modifications to loosen the attractive forces between the cellulose fibrils by preventing the formation of strong interfibril hydrogen bond and aligning the microfibrils in water by repulsive forces generated by ionization of the surface groups seem to provide interesting options to produce evenly dispersed cellulose nanofibrils in water at low process energy cost. In this study, we report surface acetylation of pulp to produce homogeneously dispersed MFC. In fact, the acetylation reaction has been known for more than a century now and serves as the base for the production of cellulose acetate. It is known that acetylation occurs at the surface of the fibers and a homogeneous acetylation is diffucult to achieve. We study the bleached Kraft eucalyptus pulp,varying degrees of fibrillation and acetylation.

The MFCs used in this study was microfibrillated in a pilot plant that consists of a rotary defibrillator of 12 inches of diameter in Technology Development Unit (UDT) of the University of Concepcion. We analyze the energy consumption and the properties of the obtained material. Subsequently, acetylation homogeneity is determined and its inclusion as a reinforcing agent in a paper formulation, an adhesive resin and a polyolefin has been evaluated. We also report the distribution of the reinforcing agent in the matrices and the mechanical properties of the obtained composite materials.

Paper-ID	29461
Paper title	Bacterial Cellulose Modified with Xylan Polyelectrolytes
Presentation format	Oral presentation
Date of submission	26.01.2017 10:20 Uhr

Authors

- Sara Santos *(santos@inia.es)* (Presenter)
- José María Carbajo *(chema@inia.es)*
- Nuria Gómez *(nuria@inia.es)*
- Miguel Ladero *(mladero@quim.ucm.es)*
- Juan Carlos Villar *(villar@inia.es)*

Content

The bacterial cellulose (BC) synthesized by *Gluconacetobacter sucrofermentans* has high purity and an ultrafine network that provides high crystallization degree, elasticity and durability, greater tensile strength than plant cellulose and biocompatibility. In previous studies, the effect of carbon and nitrogen sources in the culture medium of BC from *G. sucrofermentans* CECT 7291 was evaluated. The best combination was fructose plus yeast extract-corn steep liquor.

In this job two novel composites were obtained in two different ways, using two [4-Butyltrimethylammonium]-xylan chloride polyelectrolites (BTMAX-5, DS of 0.13; BTMAX-6, DS of 0.58) and BC. In one way, BC films were synthetized in the presence of BTMAXs. For that purpose, BTMAX-5 (or BTMAX-6) was added to the culture medium together with a cell suspension of the *bacterium*. After one week of cultivation under sterile conditions at 30 °C, the generated layers were collected and purified with an alkaline treatment, finishing with an exhaustive washing with distilled water. The other way to obtain the composites consisted of obtaining a BC gel by the mechanical disintegration of purified BC layers using a homogenizer equipment, to which subsequently the polyelectrolytes were added. Composite films were produced with these novel materials. BC films obtained in the two same ways but without xylan derivatives, were used as controls.

The main goal in the present job is to obtain and to characterize the resulting BC-BTMAX composites. The purified layers were characterized in terms of tear and burst indexes, optical properties, static and dynamic contact angles, Gurley porosity, SEM, X-ray diffraction and AFM.

Although small differences in mechanical and optical properties have been observed between the biocomposites and control films, the films via homogeneizer were remarkably more opaque. The specular gloss had values up to four times lower when the films were obtained by synthesis in the presence of BTMAXs. Additionally, the obtained film structures hardly allow the flow of air. In all cases the crystallinity of the composites is lower than that of the control material. This decrease is more pronounced in the case of the composites obtained by adding the BTMAXs to the culture medium. In view of the results, it can be concluded that the BC-BTMAX composites are a promising new material.

Paper-ID	58896
Paper title	Cellulose nanofibrils from pine stumps and rice straw: production, characterization and influence in filler-containing papers
Presentation format	Poster
Date of submission	30.01.2017 20:27 Uhr

Authors

- Ana F. Lourenço *(analourenco@eq.uc.pt)* (Presenter)
- Cátia V.T. Mendes *(cvtmendes@gmail.com)*
- José M. Carbajo *(chema@inia.es)*
- Paulo J.T. Ferreira *(paulo@eq.uc.pt)*
- M. Graça, V.S. Carvalho *(mgc@eq.uc.pt)*
- Juan C. Villar *(villar@inia.es)*

Content

Cellulose nanofibrils (CNF) are generally obtained from wood bleached pulp and cotton fibers. Nevertheless, they can be produced from lower quality raw materials not adequate to produce pulps for high-strength paper. Steam explosion has been used with success as a pretreatment step of lignocellulose biomass. This process selectively removes hemicelluloses without significant cellulose degradation, which is an advantage for the production of cellulose nanofibrils after a following delignification step.

The aim of this study is to use two types of agro-industrial and forestry residues: rice straw and pine stumps. After size reduction to obtain pine chips, the disruption of the lignocellulosic structure was achieved by steam explosion followed by organosolv process to extract lignin. The severity factor (which described the combined effect of time and temperature on the steam explosion process) was around 4. As for rice straw, organosolv process was applied. The crude pulps were bleached with oxygen and $NaClO_2$. Chemical characterization was performed before and after each step, after washing and drying.

Cellulose nanofibrils were obtained from the never dried bleached pulps produced with the two treated raw materials. For that, the pulps were oxidised with NaClO in the presence of catalytic amounts of TEMPO (2,2,6,6-tetramethylpiperidine-1-oxyl radical) and NaBr, and subsequently submitted to a mechanical treatment in an high pressure homogenizer (HPH). Due to the aforementioned delignification processes and to the introduction of carboxylic groups derived from the TEMPO-mediated oxidation, a breakup of the lignocellulosic fibres occurred and the following mechanical treatment in the HPH could be performed by passing the suspension only 2 times in the equipment (total pressure of 1500 bar). The CNF were characterized for their production yield, amount of carboxylic groups, ionic charge and size.

After, the nanofibrils were used as filler flocculant in papermaking: laboratory handsheets were produced with a bleached eucalyptus kraft pulp, precipitated calcium carbonate, CNF, cationic starch, alkenyl succinic anhydride and a cationic polyacrylamide in the following amounts: 66, 30, 3, 1, 0.12 and 0.02 wt%, respectively. The influence of the CNF in filler retention and on the main structural and mechanical paper properties was assessed by comparing the results with those of handsheets produced without CNF.

With this study, cellulose nanofibrils, a cellulosic material with huge potential, were successfully produced from biomass residues and tested as a new additive to improve the quality of printing and writing fine papers.

Paper-ID	50091
Paper title	Effective and environmentally friendly method for the production of binderless MDF
Presentation format	Poster
Date of submission	30.01.2017 15:32 Uhr

Authors

- Alejandro Rodríguez Pascual *(a.rodriguez@uco.es)* (Presenter)
- Juan Domínguez-Robles *(z42doroj@uco.es)*
- Quim Tarrés *(quimtafa@gmail.com)*
- Helena Oliver-Ortega *(helena.oliver@udg.edu)*
- Marc Delgado-Aguilar *(m.delgado@udg.edu)*
- Pere Mutjé *(pere.mutje@udg.edu)*

Content

The demand for fiberboards is continuously growing. Such materials are usually made of lignocellulosic fibers with a synthetic resin. Formaldehyde is one of the most common components in these synthetic adhesives. However, emission of this compound has caused health and environmental issues. Industries are therefore focusing on the elimination of these concerns. Enzymatic treatments of fibers may improve the properties of binderless fiberboards, owing to their ability to form free radicals on the surface of fibers [1]. The present study aims to develop medium density fiberboards (MDF) from wheat straw thermomechanical fibers. In this process, the synthetic adhesives are replaced by the enzymatic action of a β-1,4-endoglucanase. The final purpose is to produce wheat straw binderless fiberboards with enhanced properties compared to commercial MDF. WS was characterized containing 39.7% of α-cellulose and 17.7% of lignin. WSpulp was obtained through a soda pulping process, with a pulp yield of 72.6%, 9.17% lignin and 61.96% α-cellulose. WS fibers were subjected to enzymatic treatment using a β-1,4-endoglucanase (320 mg/Kg of fiber) under its optimal conditions, 60ºC, pH=4.8 and 30 and 60 min. Fiberboards were prepared through the wet process. An own sheet former machine was used to form a fiber cake, which was cut to the size of the mould and introduced into the hot press machine. Fiberboards showed an increase in the modulus of rupture of 99.4% and 138% after an enzymatic treatment of 30 and 60 min, respectively. For the modulus of elasticity, the increases achieved were 105.2% and 146.2% after 30 and 60 min of the treatment, respectively. Finally, the internal bond increase after 60 min of treatment was 26.1% compared to the commercial MDF. With the obtained results, it can be assumed that an enzymatic treatment is a promising alternative for the production of MDF with good physico-mechanical properties.

Ref. Wood Science and Technology, 2015. 49: p. 661–679.

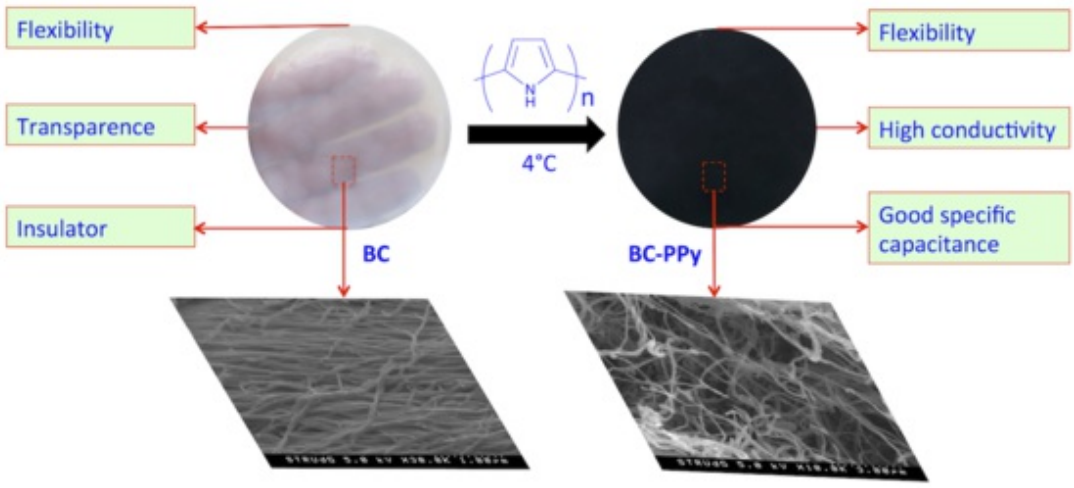

Wheat Straw

Paper-ID	87801
Paper title	High electrical and electrochemical properties in bacterial cellulose / polypyrrole membranes
Presentation format	Poster
Date of submission	28.02.2017 17:56 Uhr
Authors	- Fabiola Vilaseca *(fabiola.vilaseca@udg.edu)* (Presenter) - Makara Lay *(makara_lay@yahoo.com)* - Israel González *(israel.gonzalez@udg.edu)* - Joaquim A. Tarrés *(joaquimagusti.tarres@udg.edu)*

Content

The development of novel multi-functional nanocomposites has gained tremendous research interest during the last decade. In this direction, low cost resources, with renewable and biodegradable characteristics, are aimed for light weight, flexible and eco-friendly biomaterials intended to wearable electronics, biosensors or energy storage devices. Among the different biomaterials, bacterial cellulose (BC) is one kind of nanocellulose structure that shows outstanding properties together with a complete biodegradable and biocompatible nature. Recently, it has been investigated the use of BC nanocomposites in flexible electrodes, biosensors or supercapacitors. The combination of bacterial cellulose with conducting polymers (CP), graphene and graphene oxide, carbon nanotubes, and hybrid metal/conducting polymer has also been studied. The excellent physical-mechanical properties of BC matrix combined with highly conducting electroactive polymers are expected to provide nanocomposites with the electrical and mechanical characteristics that cannot be reached by the single materials.

The purpose of the current work was to produce conducting electroactive membranes from bacterial cellulose (BC) coated with polypyrrole (PPy) via in situ chemical polymerization of pyrrole at 4ºC using $FeCl_3$ as oxidant agent. The electrical conductivity, tensile, thermal and electrochemical properties of BC-PPy membranes were investigated. The results revealed that the uniformly coating of PPy nanoparticles on the surface of BC template achieved high electrical conductivity of 3.39 S cm^{-1} and a specific capacitance of 191.94 F g^{-1} at 5 mv s^{-1} scan rate. The high conductivity and specific capacitance of the present BC-PPy membranes opens new potential applications for BC in various fields as biosensors, flexible electronics, or energy storage devices.



Paper-ID	92571
Paper title	Next Generation Textile Filaments Based on Nanocellulose: Spinning Bifunctional Nanofibrils and Achieving Wet Strength
Presentation format	Oral presentation
Date of submission	03.03.2017 13:53 Uhr
Authors	- Orlando Rojas *(orlando.rojas@aalto.fi)* (Presenter) - Maija Vuoriluoto *(Maija.Vuoriluoto@aalto.fi)* - Hannes Orelma Orelma *(Hannes.Orelma@vtt.fi)* - Meri Lundahl *(Meri.Lundahl@aalto.fi)* - Maryam Borghei *(Maryam.Borghei@aalto.fi)*

Content

Cellulose nanofibril (CNF) hydrogels were used as a dope in the development of continuous filaments by using wet-spinning. The viscosity and spinnability, as well as orientation and strength of the filaments, were found to be strongly affected by the electrostatic charges of CNF and volume fraction. Super-strong filaments were achieved even under no drawing, with tensile strength and Young's modulus (for 83% orientation degree, WAXS) of 297 MPa and 21 GPa, respectively. A thorough investigation of the interactions with water using dynamic vapour sorption (DVS) experiments revealed the role of sorption sites in the stability of the filaments in wet conditions. We further demonstrate benzophenone (BP) conjugation via amine-reactive esters in photo-active cellulose nanofibrils that were subjected to rapid bi-radical UV crosslinking. As a result, the BP-CNF filaments developed a wet tensile strength of more than 100 MPa. Following, anti-human hemoglobin (anti-Hb) antibodies were conjugated onto residual surface carboxyl groups, making the filaments bifunctional for their active groups and properties (wet strength and bioactivity). Optical (surface plasmon resonance) and electroacoustic (quartz crystal microgravimetry) measurements conducted with the bifunctional CNF, indicated effective anti-Hb conjugation. The developed filaments based on nanocellulose offer a great promise in advanced textile materials. Moreover, bifunctional systems are valuable in detection and affinity binding, which can be engineered into other structures for rational use of material and space.

Paper-ID	94411
Paper title	Rapid Biosynthesis of Silver Nanocomposites using Mimosa pudica for antibacterial and antifungal activities
Presentation format	Oral presentation
Date of submission	22.03.2017 02:54 Uhr
Authors	- Satyam Dixit *(dixitsatyam@outlook.com)* (Presenter) - Nikita Goel *(ngoel1996@gmail.com)*

Content

Nanoscale materials have known to be crucial elements in current scientific research due to its application in electronics, medical, optical industries, etc. because of their unique properties than bulk materials such as size, large surface area and quantum confinement. This research is based on the synthesis of silver nanoparticles using Mimosa pudica leaf extract wherein these biosynthesized AgNPs were characterized by SEM, EDAX and FTIR. Further, the antimicrobial activity of AgNPs was investigated in this study. M. pudica is an annual or perennial straggling prickly sub-shrub that belongs to Mimosaceae family. Leaves of M. pudica contains Mimosine, a toxic alkaloid and mucilage which possess antiproliferative and apoptotic activities. M. pudica is a potential anti-hyperglycemic, anti-diarrhoeal, anticonvulsant, cytotoxic and hepatoprotective agent and is also used for the treatment of several diseases. The prepared AgNPs have proved to have a potential antimicrobial action against bacteria and fungi which make them a potential candidate for pharmaceutical applications. Moreover, antimicrobial properties of AgNPs found application in Biotechnology, Textile and Water Treatment process.

While there are various physicochemical methods for the synthesis of AgNPs to obtain uniform size and shape but, these methods have few disadvantages like environmental pollution, high cost etc. Hence, biological synthesis of nanoparticles is always more feasible because it is eco-friendly, requires mild conditions and is cost effective. In this study, Mimosa pudica leaf extract was used for the green synthesis of silver nanoparticles. The formed Spherical shaped AgNPs were produced with the size lesser than 100 nm and their presence was confirmed by SEM analysis. Also, EDAX analysis revealed the presence of silver in the synthesized AgNPs. FTIR results showed that phytochemicals were involved in the AgNPs formation and acted as the reducing and capping agent. The AgNPs hence synthesized using this technique were found to be potential antimicrobial agents and the results also revealed that these AgNPs can be used widely in biological and medical applications.

Paper-ID	87761
Paper title	Smart nanopaper based on cellulose nanofibers with hybrid PEDOT:PSS/Polypyrrole for energy storage devices
Presentation format	Oral presentation
Date of submission	28.02.2017 17:50 Uhr
Authors	- Fabiola Vilaseca *(fabiola.vilaseca@udg.edu)* (Presenter) - Makara Lay *(makara_lay@yahoo.com)* - Neus Pellicer *(neus.pellicer@udg.edu)*

Content

The majority of portable electronics devices such as mobile phones, transistors, notebook computers, and digital cameras are built on non-renewable, non-biodegradable, toxic materials, such as silicon wafers, which are highly purified, expensive and rigid substrates. This is why the development of nanotechnologies is focused on using environmentally friendly materials made from renewable sources. Coming from renewable and sustainable raw materials, cellulose nanofibers are strong, flexible, transparent, and exhibit low thermal expansion coefficient, which means that the material will not change shape as the temperature variations. Moreover, the combination of CNFs with conducting polymers (CPs) produces high capacitance and conductive films with the advantages of being lightweight (higher energy and power with less device mass) and flexible (Meng et al., 2010).

In the current work, flexible, lightweight, and strong conductive nanopapers based on cellulose nanofibers (CNFs) with poly(3,4-ethylenedioxythiophene):polystyrene sulfonate (PEDOT:PSS) and/or polypyrrole (PPy) were prepared by following a mixing and in situ polymerization method. A successful homogeneous coating of PEDOT:PSS on cellulose nanofibers occurred by means of interactions between PEDOT chains and the hydroxyl and carboxylic groups of cellulose nanofibers, as shown by FTIR spectra. The electrical conductivity and the specific capacitance of CNF-PEDOT:PSS nanopapers were 2.58 S cm^{-1} and 6.21 F g^{-1}, respectively. Further coating of PPy produced a substantial improvement on the electrical conductivity (10.55 S cm^{-1}) and the specific capacitance (315.5 F g^{-1}) of the resulting CNF-PEDOT:PSS-PPy nanopaper. A synergistic phenomenon between both conductive polymers supported the high electrical conductivity and specific capacitance of the ternary formulation. Moreover, CNF-PEDOT:PSS-PPy nanopaper showed higher mechanical properties and it was more flexible than the nanopaper containing only polypyrrole conducting polymer (CNF-PPy). It is concluded that the good mechanical, electrical and electrochemical properties of the ternary formulation can apply for the next generation of flexible electronics and energy storage devices.