3rd Nanocellulose Workshop

June 13-14, 2019
Campinas | Brazil

Abstract book

Program

June 13th

8:30	Reception
9:00	*Welcome & Opening Session*
9:30	**Keynote Presentation** Biobased nanomaterials and polymer nanocomposites Alain Dufresne *Grenoble Institute of Technology*
10:30	Coffee Break
11:00	**Oral Presentation** Wetting of nanocrystalline cellulose surfaces Munir Skaf *State University of Campinas (UNICAMP)*
11:30	Fast-Track Presentations
13:00	*Lunch*
14:30	**Oral Presentations** Integrated isolation of nanocelluloses and nanolignin from sugarcane bagasse within a biorefinery concept Valdeir Arantes *University of São Paulo (USP)* Flexible Nanocellulose-based Devices Murilo Santiago *Brazilian Nanotechnology National Laboratory (LNNano)* Bacterial cellulose: alternative substrates and food applications Henriette Azeredo *Brazilian Agricultural Research Corporation (EMBRAPA)*
16:00	Coffee Break
16:25	**Advanced Characterization and Sibratec** Advancing X-ray diffraction and microtomography to investigate lignocellulosics Carlos Driemeier *Brazilian Biorenewables National Laboratory (LNBR)* Characterization of nanocellulose using transmission electron microscopy Rodrigo Portugal *Brazilian Nanotechnology National Laboratory (LNNano)* SibratecNano: Funding for Innovation Juciane de Paula André *Brazilian System of Technology (Sibratec SisNano)*
17:30	*Poster Session*
19:00	Social Gathering

Program

June 14th

8:30	**Keynote Presentation** Cellulose Nanocrystal-a promising sustainable nanomaterial for advanced engineering applications Michael Tam *Waterloo Institute for Nanotecnology (WIN)*
9:30	**Oral Presentations** Nanocomposites produced from renewable resources and their applications Henrique Mattoso *Brazilian Agricultural Research Corporation (EMBRAPA)* Materials from renewable resources: Nanocellulose based films and mats Elisabete Frollini *University of São Paulo (USP)*
10:30	Coffee Break
11:00	**Oral Presentations** Biobased 3D porous materials Denise Petri *University of São Paulo (USP)* Novel chemical sensors based on composite materials containing nanocellulose for environmental analysis Daniel Correa *Brazilian Agricultural Research Corporation (EMBRAPA)* Agroindustry waste as source for production of cellulose nanofibers Ljubica Tasica *State University of Campinas (UNICAMP)* Simple preparation of cellulosic lightweight materials from paper pulp Elisa Ferreira *State University of Campinas (UNICAMP)*
13:00	*Lunch*
14:00	**Round Table Discussion**
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KEYNOTE ABSTRACTS

Biobased nanomaterials and polymer nanocomposites.

Alain Dufresne | *Grenoble Institute of Technology*

Unexpected and attractive properties can be observed when decreasing the size of a material down to the nanoscale. Cellulose and other polysaccharides (starch, chitin) are no exception to the rule. These materials are abundant, renewable, non-toxic, low density and biodegradable. In the nanoscale, some properties such as mechanical properties and surface reactivity are exacerbated. Cellulose nanomaterials are therefore promising candidates for the preparation of bionanocomposites and other nanodevices.

Although cellulose is the most available natural polymer on Earth, it is only recently that it has gained importance as a nanostructured material thanks to its hierarchical structure. Cellulosic nanomaterials are generally in the form of cellulose nanofibrils (CNF) or cellulose nanocrystals (CNC). Intense mechanical shear applied to the cellulosic fibers, thus liberating more or less individually the nanofibrils, is generally used to obtain CNFs in the form of flexible filaments. The mechanical process used and the source of cellulose both condition the diameter of CNF, generally between 2 and 100 nm. The length is more difficult to determine but is generally in the range of the micrometer. A controlled hydrolysis treatment with a strong acid can be applied to cellulosic fibers allowing dissolution of the amorphous domains of cellulose and obtaining CNC. This material consists of nanoparticles in the form of rigid needles that can be considered as a cellulose crystal without apparent defects. The precise physical dimensions of the nanocrystal depend on several factors, including the source of the cellulose used and the conditions of hydrolysis. The length is generally of the order of a few hundred nanometers and the width of the order of a few nanometers. These two nanomaterials are obtained in the form of dilute stable aqueous dispersions.

The mechanical modulus of crystalline cellulose is the basis of many potential applications. Moreover, the low thermal expansion coefficient caused by the high crystallinity of cellulose nanomaterials and high transparency without the presence of any existing polymer is highly advantageous for flexible display panels and electronic devices. For papermaking, in addition of improving the tensile strength, burst strength, tear, density, smoothness and also increasing the air permeability, the capacity of retaining the filler and the adsorption of a dye are also improved by the nanoparticles. Besides, the inherent high reactivity of cellulose and the pervasive surface hydroxyl groups associated with the nanoscale dimensions of cellulose nanomaterials open up opportunities to develop new functional nanomaterials.

With a Young's modulus of the order of 100-130 GPa and a specific surface of several hundred m2.g-1, these cellulosic nanomaterials have a significant capacity of reinforcement at low filler content. However, as for any nanoparticle, the main challenge is related to their homogeneous dispersion in a polymer matrix. A major challenge is to prepare polymeric nanocomposites using industrial techniques such as melt processing, thus avoiding liquid methods.

Cellulose Nanocrystal-a promising sustainable nanomaterial for advanced engineering applications.

Michael Tam | *Department of Chemical Engineering and Waterloo Institute for Nanotechnology - University of Waterloo*

Nanotechnology is anticipated to be the next technological wave that will drive many of the innovations in science and engineering. In this discipline, there is a renewed impetus to develop nanomaterials from renewable sources due to the negative impact of using raw materials from traditional carbon sources, such as crude oil. New opportunities in the use of sustainable and renewable material for various advanced engineering applications exist, and cellulose nanocrystal (CNC) offers a new route to product development and formulations in these industrial sectors. The talk will focus on the important role CNC functionalization plays in imparting attractive properties that are critical for their applications. I will discuss the physical interactions between CNC and various amphiphilic compounds, and how these interactions impact their stability and microstructure. In order to fully elucidate the microstructural evolution of CNC/surfactant interactions, rapid and robust characterization techniques for quantifying the evolving molecular structure were used to elucidate their morphologies and microstructure. Various functionalization strategies on the surface of CNC, such as with amphiphilic polymers, inorganic and metallic nanoparticles was developed and exploited for applications in Pickering emulsions, anti-microbial systems, engineered food systems, water treatment and sustainable catalysts. I will end my presentation with some comments on the future directions and new opportunities of CNC in other related market sectors.

POSTER SECTION

Biochemistry

Nanocell01: Co-production of Lignin Nanoparticles and Nanocellulose from sugarcane bagasse.

Braz S. Marotti[1], Valdeir Arantes[1].
[1]*School of Engineering of Lorena, University of São Paulo (USP)*

During the process of isolation of nanocelluloses from lignocellulosic material, lignin is an underutilized co-product that, despite its great potential, has limited employability. Its chemical structure is relatively complex, causing some difficulties for its application, such as low solubility in aqueous medium and the lack of dispersibility in polymer matrices. The production of lignin nanoparticles (LNP) can contribute to improve the viability of nanocellulose production through the generation of a high-value co-product. The present work has the objective of utilizing the lignin resulting from the isolation of nanocellulose from the sugarcane bagasse for the production of LNP. Characterization results of the LNP showed high uniformity, stability in aqueous medium over a wide pH range and higher UV absorption when compared to the lignin in its macro scale. Thus, the LNP produced have unique properties and its production method has advantages due to the low energy consumption, scalability, and generation of a high-value co-product with several applications.

POSTER SECTION

Chemical engineering

Nanocell02: Integration of the cellulose nanoccrystals isolation process, through enzymatic hydrolysis to the production of sugar for 2G ethanol from sugarcane bagasse.

Bárbara Pereira[1], Valdeir Arantes[1]**.**
[1]School of Engineering of Lorena, University of São Paulo (USP)

This work evaluated the viability of integrating the isolation of cellulose nanocrystals (CNC) through the enzymatic hydrolysis for production of sugars within the bioethanol production process from sugarcane bagasse (SCB). SCB was steam exploded and delignified at a bioethanol pilot plant and bleached to yield a cellule-rich pulp. Enzymatic hydrolysis at high solids loading and low enzyme loading generated a hydrolysate with >120 g/L glucose (~80% cellulose conversion). The CNC isolated from the hydrolysis residue did not require a ultrasonic dispersion and had particle size of 680 nm and diameter between 12 and 30 nm with high uniformity, crystallinity index >90% and about 50% yield. It also displayed moderate suspension stability and high thermalstability. In conclusion, the CNC showed properties similar or superior than the CNCs prepared from bleached eucalyptus Kraft pulp, indicating the technical viability for isolation of CNC from SCB as a co-product within the bioethanol production process.

Nanocell03: A preliminary assessment of integration of bionanomaterials and high concentration sugar.

Carlaile F. de O. Nogueira[1], Marina O. S. Dias[1], Valdeir Arantes[1].
[1]School of Engineering of Lorena, University of São Paulo (USP)

The pulp and paper industries face a market shift from traditional products to a new generation of forest products driven by the necessity of innovation and guarantee of profit. Nanocelluloses are promising products due to their unique properties and for many benefits to the forest biorefineries. Here, we studied the simultaneous production of CNC, CNF and a sugar stream at high concentration. After high-solids enzymatic hydrolysis of bleached kraft pulp, the sugar stream was recovered by filtration and the solid cellulosic residue (SCR) was used to extract CNC and CNF. The CNC isolation was previously optimized concerning CNC yield through an experimental design and response surface methodology that investigated the influence of the cellulose hydrolysis yield. The SCR remained was defibrillated in a disk ultra-refiner, and CNF properties were monitored by energy consumption and viscosity changes. Atomic Force Microscopy was used to confirm the isolation of the nanocelluloses and to determine their dimensions. This presentation will explore product yields in relation to potential revenue to discuss the best economic proportion. Acknowledgements: CAPES-PROAP and FAPESP.

Nanocell04: Two-stage enzymatic hydrolysis for isolation of cellulose nanocrystals and production of industrial sugar at high concentration.

Guilherme Augusto Campanário Cencio[1], Bárbara Pereira[1], Valdeir Arantes[1].
[1]School of Engineering of Lorena, University of São Paulo (USP)

This work aims to evaluate the enzymatic hydrolysis in two stages to produce sugars in high concentration and nanocrystalline cellulose (CNC) from a sugarcane bagasse cellulose-rich pulp. At the very early stage of the enzymatic hydrolysis (first stage), the enzymes are distributed in the aqueous phase and adsorbed to the cellulose, which is favored at low solids loading. After the initial adsorption equilibrium, the unadsorbed enzymes were removed by filtration and utilized increasing the solids content (second stage), which yielded a glucose hydrolysate with around 80 g/L and cellulose conversion around 70%. The unadsorbed enzymes were successfully used for another round of hydrolysis reducing the enzyme loading by about 50%, while the solid residue generated by the enzymatic hydrolysis was used for isolation of CNC with great properties, such as high crystallinity and thermal stability when compared to CNC produced by the traditional method with sulfuric acid hydrolysis.

Nanocell05: Economic viability analysis of cellulose nanocrystals production in a sugarcane biorefinery using yellow glycerin as organosolv solvent.

Gustavo Batista[1], Cristiane Sanchez Farinas[1], Antonio José Gonçalves Cruz[1].
[1]Department of Chemical Engineering, Federal University of São Carlos (UFSCar)

This work aims to evaluate the enzymatic hydrolysis in two stages to produce sugars in high concentration and nanocrystalline cellulose (CNC) from a sugarcane bagasse cellulose-rich pulp. At the very early stage of the enzymatic hydrolysis (first stage), the enzymes are distributed in the aqueous phase and adsorbed to the cellulose, which is favored at low solids loading. After the initial adsorption equilibrium, the unadsorbed enzymes were removed by filtration and utilized increasing the solids content (second stage), which yielded a glucose hydrolysate with around 80 g/L and cellulose conversion around 70%. The unadsorbed enzymes were successfully used for another round of hydrolysis reducing the enzyme loading by about 50%, while the solid residue generated by the enzymatic hydrolysis was used for isolation of CNC with great properties, such as high crystallinity and thermal stability when compared to CNC produced by the traditional method with sulfuric acid hydrolysis.

Nanocell06: Green strategies for nanocellulose production using a home-made enzymatic cocktail.

Paula Squinca[1,2], Stanley Bilatto[2], Alberto C. Badino[1], Cristiane S. Farinas[1,2].

[1]*Graduate Program of Chemical Engineering - PPGEQ, Federal University of São Carlos (UFSCar)*

[2]*National Laboratory of Nanotechnology for Agribusiness (LNNA), Embrapa Instrumentation*

This work presents environmentally-friendly strategies to nanocellulose production using home-made enzymatic cocktails. Firstly, cellulolytic enzymes were produced by Aspergillus niger cultivated under solid-state fermentation using wheat bran as solid substrate. Then, two strategies were evaluated to obtain nanocellulose: enzymatic hydrolysis of bleached kraft eucalyptus pulp (BKEP) followed or not by a sonication step. The BKEP was pretreated in a ball mill prior to enzymatic hydrolysis. The reactions were carried out in Erlenmeyer flasks with home-made enzymatic cocktail (fungal fermentation broth) and 2 % (w/v) of solids loading for 96 h and the glucose concentration and cellulose conversion were determined during the reaction. Scanning electron microscope was used to analyze the initial pulp fibers. Nanocellulose materials from both strategies (enzymatic treatment and enzymatic combined with mechanic treatment) were characterized by Field Emission Scanning Electron Microscopy, showing that it was possible to obtain nanocellulose using a non-commercial enzymatic cocktail and the combination with mechanical treatment contributed to improve nanocelullosic material dispersion.

Nanocell07: Enzymatic production of nanocellulose from sugarcane bagasse in biorefineries.

Thalita Jessika Bondancia[1,2], Jessica de Aguiar[1], Luiz Henrique Capparelli Mattoso[2], José Manoel Marconcini[2], Cristiane Sanchez Farinas[1,2].

[1]*Graduate Program of Chemical Engineering - PPGEQ, Federal University of São Carlos (UFSCar)*

[2]*National Laboratory of Nanotechnology for Agribusiness (LNNA), Embrapa Instrumentation*

The production of high-value nanocellulosic materials can significantly contribute to the overall economic viability of future biorefineries. However, there is still a need to develop strategies to produce these nanomaterials in a green and sustainable way. Nanocellulose can be obtained from lignocellulosic biomass by different methods such as mechanical, acid and enzymatic hydrolysis. Here, the feasibility of using only the enzymatic route to obtain nanocellulose from sugarcane bagasse integrated to the release of soluble sugars was investigated. For that, the fibers were initially pretreated with alkali and the enzymatic hydrolysis experiments were carried out for 96 h with a solid loading of 10% (w/v) and an enzyme loading 15 FPU/g cellulose. Cellulose conversion values up to 81% and glucose concentration of 93 g/L were achieved. The residual solids of the hydrolysis were characterized in terms of the crystallinity index (CI) by X-ray diffraction, morphology analyses by field emission gun scanning electron microscopy (FEG-SEM), and identification of functional groups by Fourier transform infrared (FTIR). The residual solid presented rodlike structures, with the predominance of nanocellulose in the solid material. The CI of the material after the enzymatic hydrolysis increased from 61 to 82%, indicating the removal of the amorphous cellulose. These findings showed that the production of nanocellulose using sugarcane bagasse by the biochemical route is a very promising strategy to add value to future biorefineries.

POSTER SECTION

Chemistry

Nanocell08: Bacterial Nanocellulose-based platform for custom in vitro 3D cell culture.

Amanda M. Claro[1], Nayara Cavichiolli do Amaral[1], Gustavo C. Monteiro[1], Hernane S. Barud[1].

[1]*University of Araraquara (UNIARA)*

Cell culture platform is a versatile device that can be applied in the biomedical field to investigate cellular responses. Bacterial Nanocellulose (BNC) is a natural biopolymer produced by specific non-pathogenic bacteria through biotechnological process. BNC films appears as an interesting support material for cell culture, as it presents distinctive properties including flexibility, biocompatibility, optical transparency and high porosity. The surface of this material, however, does not provide adequate cell adhesion, so in order to overcome this problem, BNC surface modification becomes an attractive alternative. In this sense, the present study aimed to functionalize the surface of BNC by silanization reaction in order to obtain optimized cell cultures platforms. The efficiency of the surface treatments using (3-mercaptopropyl)trimethoxysilane was highlighted by X-ray photoelectron spectroscopy (XPS) and the thermal stability of the surface functionalized BNC membranes was investigated using thermogravimetric analysis (TGA). The morphological investigation by scanning electron microscopy (SEM) revealed an increased compactness for the surface functionalized BN.

Nanocell09: Functionalized Bacterial Cellulose Membrane with natural-based colored silica nanoparticles.

Andreia S. S. Monteiro[1], Rafael R. Domeneguetti[1], Michel W. C. Man[2], Hernane S. Barud[1], Carole Carcel[2], Sidney J. L. Ribeiro[3].

[1]*Institute of Chemistry - São Paulo State University (UNESP)*

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[3]*University of Araraquara (UNIARA)*

The development of Bacterial Cellulose Membrane (BCM) with functional and innovative properties, to enhance its excellent properties, has been one growing field of interest in recent years. This work reports the development of economic and environmentally friendly BCM with natural colored based properties. This functional BCM, with a view to being applied, for example, in the textile industry, as artificial textiles and highly absorbent materials, or in paper industry, overcome the limitations and environmental problems, namely the color fastness and the contamination of the effluents. Silica nanoparticles obtained through agro-industrial waste, namely rice husk, were functionalized with natural dye obtained through natural extracts, namely curcuma. Subsequently, these nanomaterials were incorporated into BCM, by in situ methodology. The curcuma is one of the most powerful chemopreventive and anticancer agents. Its biological effects range from antioxidant, anti-inflammatory to inhibition of angiogenesis and is also shown to possess specific antitumoral activity. These properties will add value in the BCM, extending therefore their use to a wide range of highly applications.

Nanocell10: Protective coatings based on nanostructures of cellulose and lignin extracted from elephant grass.

Camilla Henriques Maia Camargos[1], Camila Alves Rezende[1].
[1]University of Campinas (UNICAMP)

Lignocellulosic biomass is an environmentally and economically sustainable resource for manufacturing nanostructures of both cellulose and lignin. Therefore, aiming at designing new nanocomposites, we used elephant grass leaves to obtain cellulose nanocrystals (CNC) and nanofibrils (CNF), as well as lignin nanoparticles (LNP). In aqueous media, the stabilized nanostructures (ζ potentials lower than – 40 mV at pH 6-7) were combined to prepare coatings for cellulosic substrates (paper, wood, and textile). CNF and CNC ensured the formation of a consistent film. Nanocomposites with LNP 1% and 2% (w/w) were transparent, colorless and presented UV-absorbing capability, which is interesting for the development of protective coatings. The incorporation of more than 5% LNP caused browning and decreased the film transparency, but also improved film barrier to UV light and antioxidant activity in ethanol extracts. Furthermore, coatings applied on cellulosic substrates were homogeneous, thin, and presented a surface with uniform microscopic topography. Thus, different green nanomaterials could be successfully combined for designing new nanocomposites.

Nanocell11: Cellulose Nanofibrils extracted from sugarcane bagasse and their application in pickering emulsions

Caroline Ezequiel de Paulo da Silva[1], Juliana da Silva Bernardes[2], Watson Loh[1].
[1] Institute of Chemistry, University of Campinas (UNICAMP)
[2]Brazilian Nanotechnology National Laboratory (LNNano) - CNPEM

In the present work, we explored the use of cationic nanocellulose (CN) isolated from sugarcane bagasse as stabilizers and rheology modifiers for Pickering emulsions. Cationization reactions were conducted in 3 molar ratios glucose:GTMAC (cationization agent): 1:2, 1:5 and 1:10. The degree of substitution (DS) of CNs was measured by conductometric titration, while the morphology was monitored by TEM and AFM. The rheological behavior of CNs suspensions was also evaluated. Pickering emulsions were prepared by one-step mixing of an aqueous phase (containing CN 0.5 and 1.0%) and an oil phase (almond oil), the O:W ratio used was 30/70. These emulsions were characterized by rheology and LUMiSizer techniques. By increasing the Glc:GTMAC molar ratio, the DS increased and reduced the CN aspéct ratio. CNs dispersions and Pickering emulsions presented a gel-like rheological behavior (G'> G") and seemed to be more influenced by the CN concentration. The colloidal stability and creaming process of these emulsions were followed by LUMiSizer. CNs concentration also had a dominant effect on the instability index. Besides, most of the prepared emulsions did not phase separate even after 60 days.

Nanocell12: Easy and direct synthesis of magnetic chitosan.

Franciele da Silva Bruckmann[1], Higor de Bitencourt Rodrigues[1], Ana Carolina De oliveira Moreira[1], Theodoro da Rosa Salles, Sergio Roberto Mortari[1], **Cristiano Rodrigo Bohn Rhoden[1].**

[1]Franciscan University (UFN)

Chitosan is a biopolymer rich in functional groups of the amine class, obtained through the deacetylation of chitin. It is biocompatible, non-toxic, biodegradable, with antifungal and antimicrobial activity having a great importance in the pharmaceutical and chemical area (CHI, 2015). Another important feature of chitosan is its ability to incorporate magnetic nanoparticles in its surface, showing exceptional properties, such as contaminant removal, drug loading, theranostic, and antibacterial and antifungal properties (KLOSTER, 2018). The aim of this work is the development of an easy, efficient and environmentally friendly (green chemistry principles) protocol for the incorporation of nanoparticles with different amounts of iron to chitosan for later applications in the synthesis of nanobiofungicide reagentes.

Nanocell13: Enabling and controlling polyelectrolyte adsorption onto nanocellulose aerogels through surface cationization.

Daiane Batista da Silva[1], Caio G. Otoni[1]**,** Juliana S. Bernardes[2], Watson Loh[1].

[1]Institute of Chemistry, University of Campinas (UNICAMP)

[2]Brazilian Nanotechnology National Laboratory (LNNano) - CNPEM

Nanocelluloses merge the inherent properties of nano-sized materials with intrinsic characteristics of cellulose, e.g. wide availability, biodegradability, and surface modification capacity. This project aimed at the production of highly porous, light-weight aerogels using cellulose nanofibers (CNFs) from Eucalyptus and their functionalization through the adsorption of polyelectrolytes. For this, the CNFs were granted positive electrical charge upon the reaction with 2,3-epoxypropyl trimethyl ammonium chloride (EPTMAC) before serving as supports for the layer-by-layer adsorption of the polyanion sodium alginate and the polycation chitosan. The materials were characterized through elemental analysis, ζ potential, and potentiometric titration in order to investigate cationization and polyelectrolyte adsorption efficiencies. In addition to the number of alternated bilayers, increased surface charge in cationic CNFs – induced by varying CNF:EPTMAC proportions – enhanced the electrostatic attraction among the species and boosted the adsorption capacity. These results have clear implications in the contexts of sustainable and multifunctional materials.

Nanocell14: Development of hybrid pectin hydrogels, cellulose nanocrystals and hydroxyapatite for application in bone tissue engineering

Daniele Mayara Catori[1], Elizângela Hafemann Fragal[2], Adley Forti Rubira[2].
[1]*University of Campinas (UNICAMP)*
[2]*State University of Maringá (UEM)*

In this work hybrid hydrogels of pectin, cellulose nanocrystals (NCCs) and hydroxyapatite (HAp) were synthesized. These hydrogels were tested as temporary extracellular matrices in the induction and development of bone tissue cells. The hydrogels were synthesized by the polymerization of pectin with the NCCs. For this, vinyl groups were introduced on the surface of pectin and NCCs by chemical modification with glycidyl methacrylate and maleic anhydride, respectively. The matrix modifications were monitored by NMR and FTIR techniques and the morphology of pectin hydrogels and NCCs were analyzed by SEM. Hydroxyapatite was formed on the hydrogel structure by biomimetic method for 7 and 14 days. The percentage of HAp formed on the surface of the hydrogels was determined by thermogravimetry and the mechanical properties were evaluated. The toxicity of these hybrid hydrogels was evaluated against fibroblasts (L929) and pre-osteoblasts (MC3T3-E1). The results demonstrated that the presence of cellulose nanocrystals influences the formation of hydroxyapatite formed by the biomimetic method. The analyzed materials are cytocompatible and have the capacity to be used as future scaffolds.

Nanocell15: Interaction of linter nanocellulose with iron and manganese ions in aquatic systems.

Danielle Goveia[1].
[1]*São Paulo State University " Júlio de Mesquita Filho" (UNESP)*

With the expansion of nanotechnology and its development the cellulose became a study project in the form of nanocellulose being considered as an innovative material. How will this material interact with ions present in aquatic systems? In this work a new material from cotton linter was obtained through acid hydrolysis using 64% w / w sulfuric acid at 60ºC for 30 minutes. For the interaction studies between the Fe (iron) and Mn (manganese) ions were prepared standard solutions (2.0 mg L-1). Different volumes of solution containing nanocellulose were added. The kinetic study was done using an ultrafiltration system containing 1 kDa membrane. Where the filtrate contains the free metal (non complexed metal). Aliquots were colleted from 0-24 hours and the metal determined by flame atomic absorption spectrometry. It was observed that the interaction is higher for iron ions than for manganese ions. The kinetics occur from 0 to 240 minutes. By adding 100 µL of solution containing cellulose nanoparticles we already have a maximum of interaction that extends up to 1200 µL. Knowledge of this metal-nanocellulose interactions is important and serves as an alert to regulatory agencies.

Nanocell16: Squeezing oranges into commodities that benefit mankind.

Danijela Stanisic[1].
[1]São Paulo State University " Júlio de Mesquita Filho" (UNESP)

Brazil is leading the World's production of sweet oranges (Citrus sinensis), where just the state of Sao Paulo produces around 13-15 million tons of this fruit. Brazilian citrus juice industries are generating around 7 million tons of waste that are underutilized. Citrus waste is rich in sugar, pectin (15 - 30%), cellulose (18 %), hemicellulose and lignin (up to 4.5%). Cellulose is a linear semi-crystalline homopolymer organized in parallel chains into microfibrils and fibrils which are enveloped with lignin, hemicellulose, and pectin in the case of citrus peels. Our research group proposes a cheap, simple and quick process for isolating cellulose from this biomass and its use for a nanocellulose production. The proposed nanocellulose production process is free from organic solvents and does not exclude other commodities production - pectin, hemicellulose, lignin, and/or other substances, and is being adopted to a pilot scale-up. Obtained nanocellulose is very pure and might find many applications such as stabilizer of (a) nanoparticles of water-insoluble drugs or (b) magnetic nanoparticles or can be used in the preparation of (c) biodegradable transparent paper and (d) composite.

Nanocell17: Hybrid materials for bone tissue engineering from biomimetic growth of hydroxiapatite on cellulose nanowhiskers.

Elizangela H. Fragal[1], Thelma S.P. Cellet[1], Rafael Silva[1], Adley F. Rubira[1].
[1]State University of Maringá (UEM)

Cellulose nanowhiskers (CNWs) with different surface composition were used to generate the biomimetic growth hydroxyapatite (HAp). Hybrids materials primarily consist of CNWs with HAp content below 24%.CNWs were produced by different inorganic acid hydrolyses to generate cellulose particles with surface groups to induce HAp mineralization. In the present study, we evaluate the use of CNWs prepared from hydrochloric acid, sulfuric acid and phosphoric acid. HAp growth was obtained from the biomimetic method using a simulated body fluid concentration of 1.5 M (SBF). The sulfonate and phosphonate groups on the CNW surface have a direct impact on the nucleation and growth of HAp. HAp/CNW were also compared with the physical mixture method using HAp nanoparticles prepared by chemical precipitation. The bioactivity and biocompatibility of the hybrid materials were assessed by cell viability studies using fibroblast cells (L929). The materials obtained from the biomimetic method have superior biocompatibility/bioactivity compared to the material synthesized by the wet chemical precipitation method with an incubation period of 24 h.

Nanocell18: Sensing platform based in cellulose nanowhiskers and reduced graphene oxide associated with electrospun nanofibers for electrochemical detection of mercury (II)

Kelcilene B. R. Teodoro[1], Fernanda L. Migliorini[1], Murilo H. Facure[1,2], Daniel S. Corrêa[1].
[1]*Nanotechnology National Laboratory for Agriculture (LNNA), Embrapa Instrumentation*
[2]*Department of Chemistry , Federal University of São Carlos (UFSCar)*

Recent studies have pursued improvements in sensing devices, as the strategy of electrode surface modification using nanostructured materials. For instance, electrospun fibers combined with conductive materials enable increasing electrodes surface area and signal amplification. Within this scenario we have synthesized, through a simple and green route, a hybrid material based on cellulose nanocrystals (CNC) and reduced graphene oxide (rGO). The surface molecules of cellulose led to partial reduction of oxygen organic functions of graphene oxide, resulting in rGO. The obtained hybrid system was then employed to modify polyamide 6 (PA6) electrospun fibers, which was used in a electrochemical sensor for detecting Hg(II) using differential pulse voltammetry (DPV). Detection essays revealed that the sensor was capable to detect Hg (II) with a low limit of detection of 0.0052 µM in a concentration range of 2.5–200 µM. The sensor showed good stability, high selectivity, low detection limit and wide dynamic linear range for the detection of Hg(II). Acknowledgements: FAPESP (2014/21184-5, 2015/13140-0, 2017/12174-4), Capes, CNPq, MCTI-SisNano, FINEP and Embrapa AgroNano research network

Nanocell19: Nanofibers obtained from sugarcane bagasse under oxidation and without mechanical defibrillation

Lidiane O. Pinto[1], Juliana S. Bernardes[2], Camila A. Rezende[1].
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Cellulose nanofibers (CNFs) require a significant mechanical action to be isolated from lignocellulosic materials. However, the use of a previous treatment, like TEMPO-oxidation, can facilitate fiber disassembling due to electrostatic repulsion between the anionic charged groups - carboxylate ions (RCOO-) - on the surface of the fibers. In this study, sugarcane bagasse and eucalyptus chips pretreated and bleached were oxidized using a 2,2,6,6-tetramethylpiperidine-1-oxyl (TEMPO)-mediated system with different amounts of oxidant agent (5, 25 and 50 mmol/g cellulose). Results of atomic force microscopy (AFM) showed that sugarcane bagasse pulp oxidized with 5 mmol/g of cellulose were partially disintegrated without complete individualization, while fibers oxidized with 25 and 50 mmol/g disaggregated without high-energy mechanical treatments, presenting dimensions of CNFs, with kinks and diameters in the 3-5 nm range. The same result was not observed in eucalyptus biomass due to the higher recalcitrance of this biomass. Sonication of the highly oxidized sugarcane bagasse cellulose pulps broke down these CNFs into cellulose nanocrystals due to the cleavage of interchain bonds.

Nanocell20: Effect of the pH film-forming solution and the reinforcement ability of CNCs on properties of gelatin films for food packing

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The growing demand for plastic production has led to global waste disposal crisis. Nowadays, a large number of researches focus on solving the problem in order to obtain biodegradable packaging. Gelatin is a soluble protein that exhibits film-forming properties, low cost, and biodegradability. However, using only proteins is not enough for producing food packaging with satisfactory properties. A way to increase the properties of these films is the use of cellulose nanocrystal as reinforcement2. The objective of this study was to evaluate the effect of cellulose nanocrystals and the influence of the pH film-forming solution on the triple-helix content, on the properties of gelatin films obtained by casting. The tensile strength and Young's modulus of the films have been improved by the addition of CNCs. This effect was more pronounced for gelatin film reinforced with 0.5 wt% CNCs at pH 8 and this can be attributed to the high content of triple-helix configurations. The barrier to water vapor and the resistance water solubility has also been improved at 0.5 wt% CNCs. The authors thanks the Fapesp (process n° 2016/03080-3 and 2018/00278-2) for support.

Nanocell21: Synergic effect of cationic/anionic CNFs association on preparation of porous materials.

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Porous materials possess a wide range of applications due to its low-density and high surface area. Although traditional inorganic materials can present well defined pore structure and stablished preparation methods, its fragility can be a drawback in many systems. As option, polysaccharide foams can be prepared combining easy preparation procedures and adequate mechanical properties. Here, several characteristics of nanocellulose foams are investigated. Abundant and non-toxic, such nanoparticles allow the preparation of porous materials with controlled pore size and compression resistance according to system composition and freezing conditions. The association of negative and positive charged CNFs in aqueous medium prove to be an elegant way to modify viscosity and structure of the suspensions, as demonstrated by SAXs experiments. As consequence, cellular structure of obtained foams differs according to the positive/negative ratio of particles. A clear sinnergy emerges, increasing foam's energy absorption and compression modulus. Finally, the compaction of different samples and its possibility to swell after hydration are discussed in terms of foams micro and nanostructure.

Nanocell22: Sustainable water-based adhesives.

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Sustainable adhesive formulations based on latex, cellulose and lignin were produced in a simple, economic and versatile manner. Their compositions do not include organic solvents or formaldehyde, following a worldwide concern for the development of water-based materials which are safer for human health and for the environment. The applications are countless, ranging from homogenous to heterogeneous substrates as different types of wood, plastics, paper, paperboard and others. Following international standards, mechanical tests were performed and the results obtained were comparable to commercial formulations already available for the same substrates. In some of the tests, even the wood test pieces suffered rupture leaving the adhesive joints intact. Furthermore, adhesive joints were analyzed by x-ray microtomography and the interface was not perceptible, indicating a good interaction between the substrate and the adhesive.

Nanocell23: Highly photostable and fluorescently modified cellulose nanocrystals (CNCs) for bioimaging.

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Cellulose nanocrystals (CNCs), are a unique and promising natural material extracted from native cellulose by acid hydrolysis. The prominent biological features including special surface chemistry, low toxicological risk, negligible inflammatory response, and the ability to penetrate cells make CNCs a promising candidate in biomedical applications (1). Consequently, nanocellulose-based imaging probes have received considerable attention in recent years. In this context, herein, we report fluorescently modified CNCs by incorporating perylenediimide (PDI) and PEGylated biotin as grafting moieties via acid-amine coupling approach. By taking account of excellent biocompatibility and photostability of covalently modified fluorescent CNCs, we evaluated their cellular interactions with J774.A1, NIH-3T3 and HeLa cells to study their cellular uptake, internalization, and localization by using optical microscopes and flow-cytometry analysis.
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Nanocell24: Crystallization pressure of salts as a new method to promote defibrillation of cellulosic substrates.

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Solutions of salts may diffuse into porous structures damaging then as the salt crystallizes in a confined environment. Salt crystallization pressure is well known in the area of civil construction, where it results in negative consequences due to the deterioration of concrete structures[1]. Because of the porous nature of the delignified cellulosic substrates[2], this interesting property of salts can be used as a mechanical treatment to promote defibrillation, thus facilitating the preparation of nanocelluloses. In this work, cell wall rupture caused by the crystallization of Na2SO4 and MgSO4 in elephant grass were evaluated by scanning electron microscopy. Another method of defibrillation, using solutions of MgSO4 (23.3 w/w), NaOH (5% w/w) and also glycerol, associated with mechanical shear was also applied. In both cases, fibrilation of the cell wall could be observed, opening new possibilities to pretreat delignified substrates and to produce cellulose nanofibrils.

1. Ruiz-Agudo, E. et al., Environ. Geol. 52, 269–281 (2007). 2. Rezende, C. A. et al., Biotechnol. Biofuels 4, 54 (2011).

Nanocell25: A potential bioproduct with high-added value from sugarcane straw.

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Cellulose nanocrystals (CNC) are a potential bioproduct with high-added value that can be obtained from lignocellulosic biomass, according to the biorefinery concept. Besides the additional production of ethanol, full use of the lignocellulosic biomass will contribute to the economics of future sugarcane biorefineries. In this study, we propose a novel use of the sugarcane straw to produce cellulose nanocrystals. The raw material was characterized regarding the pretreatment process and contents. Physicochemical characterizations were performed in order to understand changes in chemical and structural properties. An efficient isolation of cellulose was reached after different pretreatments conditions. The CNC´s were prepared by sulfuric acid hydrolysis and the influences of hydrolysis conditions and mechanical treatments were evaluated. All produced materials were characterized using FTIR, XRD, TG, SEM and FESEM analysis. Results indicated the effective isolation of cellulose in sugarcane straw and the obtained CNC´s presented high crystallinity and size range between 250 - 350 nm of length and 15 -25 nm of diameter, showing the feasibility of obtaining CNC´s from sugarcane straw.

POSTER SECTION

Food Science and Technology

Nanocell26: Cellulose Nanocrystals stabilizing O/W pickering emulsion obtained by ultrasound process.

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Cellulose nanocrystals (CNCs) are bio-based solid particles arisen as promising stabilizers for Pickering emulsions in the food, pharmaceutical and cosmetics industries. This study aimed to understand the stabilization mechanism of oil-in-water Pickering emulsion using CNCs as stabilizing particles. CNCs were obtained from cellulose microcrystalline after acid hydrolysis, dialysis, ultrasound treatment and vacuum filtration. Atomic force microscopy (AFM) showed a separated network of CNCs, with the shape of needles. We prepared course emulsions stabilized by CNCs using rotor-stator (10,000 rpm/3 min) followed by ultrasonication process to obtain fine emulsions (535 W/ 4 min). An emulsion control was prepared under more intense process conditions in rotor-stator (10,000 rpm/ 3 min and 13,000 rpm/ 3 min). We evaluated the effects of the volume fraction of the flaxseed oil phase (2.5%, 5% and 7.5% w/w) and CNCs particles concentration (0.5% and 1.0% w/w) on the emulsion properties. CNCs showed good stability against agglomeration due to the higher electrostatic repulsion after the ultrasound process and vacuum filtration (from -24mV to -33mV). Emulsions stabilized by CNCs were opaque

Nanocell27: In-situ modification of nanocellulose from soybean waste.

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Soybean's one of the most produces oleaginous in the world, with the world's planted area of 126 million hectares, producing 3 to 4 tons of waste per hectare. This waste is mainly burned or left in the field as organic compounds. A new destination with low environmental impact is aimed. The production of nanocellulose has shown to be a potential alternative. In this work we obtained nanocellulose from soybean waste, by mechanical milling, with three different times: 6, 9 and 12 h. To evaluate the efficiency in the improvement of nanocellulose stability, it was developed a new approach in-situ modification method using an anionic surfactant. The nanocellulose showed a significant decrease in the dimensions and an increase in the electrostatic stability, verified by zeta potential. The samples didn't show morphological differences. The modification increased the thermal stability, which could improve the applicability of the nanoparticles in nanocomposites by melting processing. It was observed a successful in-situ modification, that occurred by physical adsorption. Using this method, it was possible to obtain a modified-nanocellulose by a single-step method with excellent stability.

Nanocell28: Evaluation of different corn residues to produce nanocellulose.

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Corn grains are a wide produced commodity in all world. About 7,41 to 11,12 tons per planted hectare of corn residues are available every crop as an abundant and renewable source for natural fibers. Corn stover consists of the corncobs (1), husks (2) and stalks/stem (3). After corn harvesting, there is the generation of much maize waste that is constituted by different cellulosic contents. In this work, we produced nanocellulose (NC) from corn plants parts 1, 2 and 3 and evaluated the properties of the nanoparticle properties obtained. The NCs were produced by mechanical milling during 6, 9 and 12 hours. The lignocellulosic contents were analyzed to check lignin, hemicellulose and cellulose contents. The dimensions, superficial charges, and morphology of NCs were analyzed after each milling time. Sample 2 generated NC with the highest cellulosic content, smaller size and highest availability of hydroxyl groups. This behavior is due to high cellulose purity, that resulted in better fibrillation of the NC.

POSTER SECTION

Forest engineering

Nanocell29: Analysis of databases and search terms for scientific monitoring in nanocellulose.

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Nanocelulose is a nanomaterial with a great potential for innovation that has shown to be economically promising with a significant increase in research and development activities in recent years around the world. The quantitative analysis of the evolution of the quantity of articles in this field of research is long, in order, the "ScienceDirect" platform was used and the terms "nanocellulose" and "environmental nanocellulose" were searched to evaluate the evolution of publications. It is possible to verify that increased research on this issue and consequently the gain of importance of nanocellulose materials in the last decade. It is clear that the number of publications for "nanocellulose" (629) and "environmental nanocellulose" (324) in 2018 is almost one hundred and five times higher than the publications made in 2008 (6) and (1). which means that in ten years, the works that refer to the concepts discussed here have increased enormously. In addition, for the term "silica nanoparticles" is obtained 9773 publications only in the year 2018.

POSTER SECTION

General Biology

Nanocell30: Application of Accessory Enzyme for Improved Isolation of Cellulose Nanocrystals by Enzymatic hydrolysis with Endoglucanase.

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Cellulose nanocrystal (CNC) is emerging bionanomaterial with an increasing number of applications in various industrial sectors. The enzymatic isolation of CNC is a controlled and ecofriendly process that allows to obtain CNC with improved properties, but the process is still poorly studied. In this study the ability of an endoxylanase enriched enzyme preparation was investigated, as an auxiliary enzyme, to increase the selectivity of an endoglucanase for the hydrolysis of the disordered regions in cellulose microfibrils to prepare CNC with high improved properties. Combinations of the enzymes with xylanase activity equal or higher than the endoglucanase loading resulted in greater potential for CNC isolation, since under these conditions the application of xylanase improved particle size reduction, increased size uniformity, and did not alterned the high cellulose´s thermal stability. In conclusion, the beneficial effets observed with the application of xylanse as an accessory enzyme was not related to xylan hydrolysis or improved overall hydrolysis effieicney and they were independent of the cellulose source and chemical composition of the cellulosic pulp.

POSTER SECTION

Materials and Metallurgical Engineering

Nanocell31: Influence of the addition of nanocellulose on superabsorbent starch hydrogels for agricultural applications.

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Agriculture is one of the main economic activities of Brazil, demanding a high productivity and the constant development of new technologies. Hydrogels can be used in agriculture because of their low-cost and biodegradable character, that maximize the delivery of water to the soil. In this work, superabsorbent hydrogels reinforced with nanocellulose – NC - (1, 3 and 5 wt%) were prepared and characterized by water absorption, rheology and scanning electron microscopy. The maximum storage modulus was observed in hydrogels with 3 wt % of NC. The nanoparticles act as both a filler and a cross-linker, making the hydrogel more elastic, dimensionally stable, and capable of adsorb more water due to the increase in the available hydrophilic groups. The results show a significant reinforcement effect due to the addition of NC and changes in the matrix network structure were induced by the NC. The addition of nanocellulose resulted in hydrogels that can maintain their integrity for longer, which allows their long-lasting applications (for example, during a harvest). The material developed is rich in organic matter and it is expected that it will act to enrich the soil after its degradation.

Nanocell32: Nanocellulose-alginate based thin films: an alternative for wound dressing.

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Hydrogels are non-fluid polymers or colloidal cross-linked networks that are expanded by water. Due to their softness and high capacity to retain liquid, they present similarities to living tissues and exhibit adequate biocompatibility. Hydrogels have sparked interest in drug delivery applications since bioactivity molecules could be loaded into the gel matrix and then released at a rate dependent on the diffusion coefficient of the small molecule through the gel network. Despite the advantages mentioned above, hydrogels have limitations. The mechanical properties (low elastic moduli) restrain their use in different administration forms and can result in disruption or flow away of the biomaterial from a target area. In this work, the effect of adding cationic cellulose nanofibers (CNF) to alginate-based hydrogels was analyzed. Preliminary results reveal that by controlling the flocculation of cationic CNF + alginate dispersion, the mechanical stability of the obtained hydrogels improves considerably.

Nanocell33: Mapping of the Brazilian Groups Studying Nanocellulose.

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The nanocellulose is a material that has gained much attention in the recent years. So, the relevance of Brazil in this field was evaluated concerning the scientific publications in Web of Science. Next, the Brazilian groups were mapped using a bibliometric procedure on these data. Then, more factors were analyzed from them too. They were the sources to extract the nanocellulose in Brazil, the methods to do it, the characterizations to determine its dimensions and the funding agencies of these researches. The results identified 69 Brazilian groups. Besides, the bacterial cellulose was the most common source. While the acid hydrolysis was the most used method. By its turn, the size characterization was mostly by scanning electron microscopy. At last, the most important agencies were the CNPq, the CAPES and the FAPESP. Giving these points, it was possible to suggest the opportunities to develop the nanocellulose research in Brazil.

Nanocell34: Thermoplastic Starch nanocomposits reinforced with cellulose nanocrystals.

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Brazil is a country that produces a large quantity of different lignocellulosic residues. Consequently, much research to define an environmentally acceptable destination has been conducted. In parallel, the rise of nanotechnology in the last 50 years has contributed to the development of materials with improved properties, making interesting the use of lignocellulosic fibers for the production of a nanostructured material to be applied in composites. Nanostructured cellulose (CNC) has good mechanical properties and is interesting for use as reinforcement in polymer matrix composites. In this work the CNC was extracted from the sugarcane bagasse by means of the high intensity sonication process and applied in thermoplastic starch composites (TPS). TPS and nanocomposites were obtained using a simple magnetic stirring and heating methodology. Nanocomposites were obtained by compression molding with 1% sonicated fiber in relation to the starch mass. Although analysis of X-ray diffraction and scanning electron microscopy indicated that the starch gelatinization process was incomplete, a 140% increase in stress at maximum strength and 180% in elastic modulus was observed.

Nanocell35: Rheological Properties of NFC Dispersions and Correlation to Different Microfluidization Conditions.

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High specific strength, tissue compatibility and bio-degradability are appealing properties of nanocellulosic materials. Consequently, there is increased interest in developing new pharmaceutical, packaging and food applications for nanocellulose. One promising application field for nanofibrillated cellulose (CNF) is flexible electronics, due to its ability to suspend inorganic materials in water. A combination of chemical and mechanical treatments produces a gel like dispersion of cellulose nanofibers network, in which the inorganic particles are dispersed. However, to obtain smaller and more evenly distributed particles, the dispersions need to be exposed to several high shear rates cycles, which can damage the nanofibers. In this work, we present a correlation between processing, structure and property of nanocellulose dispersions. The number of cycles to which the dispersions is submitted changes the morphology of the materials, which, in turn, affects the dispersions rheological properties. Dispersions' rheological properties were characterized with oscillatory rheometer (concentric cylinders geometry) and the morphology was analyzed with scanning electron microscopy.

Nanocell36: Preparation and characterization of cellulose nanocrystals from cotton linter reinforced gelatin bio-nanocomposite.

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This work aimed to evaluate potential use of the cellulose nanocrystakl obtained from agroindustrial wastes to develop bio-nanocomposite hydrogels. Cellulose nanocrystals (CNC) were obtained from cotton linter fibers by acid hydrolysis with acid sulfuric 60 wt%. Next, gelatin crosslinked with N,N'-methylenebisacrylamide reinforced with CNC were prepared. Gelatin/CNC nanocomposite hydrogels were prepared by Michael-type reaction in an aqueous suspension of CNC. After the addition of CNC , the Tg decreased to about 133.2 ˚C to 129.9 ˚C. Compared to the neat gelatin hydrogel, the compressive modulus of the nanocomposite with 5 wt.% CNC was enhanced by 288%. CNC-containing hydrogels was found to have higher water retention time compared to neat hydrogel. The nanocomposites not only show significantly enhanced mechanical properties at low nanocellulose loading but are also highly water retention capacity.

Nanocell37: Wound dressing based on nanocrystalline cellulose membranes.

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Wound dressing based on nanocrystalline cellulose membranes. Cellulose is an abundant natural polymer and materials from renewable sources has motivated a number of studies because it is eco-friendly. On the other hand, the drug release technology represents one of the boundaries of science, involving different multidisciplinary aspects and contributing to the advancement of human health. This work aimed to the development of a biomaterial to wound dressing based on nanocrystalline cellulose (CNC). For this, the nanocelulose was obtained from natural source, characterized by different techniques, such as: X-Ray Diffraction, Atomic Force Microscopy, Zeta Potential, Fourier Transform Infrared Spectros

Nanocell38: Pineapple crown fibers as a promising source of cellulose nanocrystals.

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Unprocessed agro-industrial residues are abundant sources of cellulose that are still going to waste because of the lack of knowledge about their economic uses. Each year, more than 3 billion tons of pineapple crown by-products are disposed worldwide. Due to their low cost and high cellulose content (74-83 wt%), pineapple crown fibers (PCF) arise as a promising source to extract cellulose nanostructures. In this study, we describe for the first time the isolation and characterization of cellulose nanocrystals (CNC) from PCF. CNC with average diameter of 39 nm and high crystallinity index (73%) was successfully isolated using chemical treatments followed by acid hydrolysis with sulfuric acid. The presence of surface sulfate groups identified by elemental analysis led to low thermal degradation (124 ºC) of CNC. The high moisture content and absorption of CNC indicated their high hydrophilicity. Results showed that CNC isolated from PCF have interesting properties to be used in many liquid media applications, besides their use as reinforcement in nanocomposites with bio-based matrices such as starch and chitosan, where low processing temperatures are usually employed.

Nanocell39: Effect of cellulose particle dimension on thermal and mechanical properties of PP/cellulose composites and nanocomposites.

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The use of cellulose as a reinforcement for polymeric composites has arisen in the last few years because of the considerable environmental considerations and the concern for the development of sustainable materials. However, the final properties of the materials depend mainly on the scale and reinforcement content added to the polymeric matrix. In the present work, polypropylene (PP)/cellulose composites, produced by injection molding, were characterized as to their thermal and mechanical properties with the main objective of understanding the relationship between scale/reinforcement content and material final properties. The commercial bleached eucalyptus Kraft pulp was used as cellulose fiber (10-30 wt%) and after enzymatic hydrolysis a cellulose nanocrystals was obtained and used as reinforcement in the proportions up to 5 wt%. The effect of scale/reinforcement content on the mechanical and thermal properties will be discussed with respect to results from tensile tests and thermogravimetric analysis in order to predict the better combination that provides the most expressive increase in the final properties of composites and nanocomposites.

Nanocell40: Rapid Method for Determination of Consistency of Microfibrillated Cellulose Using Near Infrared and Chemometric Approaches.

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Microfibrillated cellulose (MFC) emerges as a potential material for diverse application. The production on commercial scale still a challenge though, and one of the major barriers is the quality of the microfibrils. Consistency of microfibrillated cellulose is a basic parameter of the suspension. Gravimetric methods are used to measure consistency, this process, however, may take 24 h. In this work, we propose a fast method to determine consistency of MFC by NIR-spectroscopy. Two batches of cellulose microfibrils – Eucalyptus and Pinus – were prepared in laboratory by the grinding method. Suspensions ranging from 2.8% to 0.1% consistency were prepared. By using partial least square (PLS), we selected the regions from the spectra that presented significant variation as far as consistency. These regions were used to build the calibration model, which could accurately (R^2: 0.988; RMSEP: 0,08%) distinguish differences in the consistency of MFC. The robustness of the NIR-PLS model was verified using external validation. The results from Gravimetric method and our NIR-PLS model correlate with coefficient over 0.9. Thus, we provided a rapid method for determination of consistency of MFC.

Nanocell41: Reuse of organic wastes for nanocellulose production to flexible membranes.

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Cellulose was isolated from wood was only in 1842 by the French chemist Anselme Payen. The hydrophilic characteristics of cellulose have been known for a long time; it has several applications in many areas such as in the paper industry, in biomedicine, and also in composites reinforcement. However, with the depletion of non-renewable sources, due to the population growth, it is essential to develop cellulose from alternative sources to supply the pulp demand, preferring wastes and tailings to use as production materials. Thus, the present study aimed to use organic wastes from citrus bergamia fruit peel; samples was harvested in the region of São Lourenço do Sul - RS; the production of cellulosic fibers occur by hydrolysis extraction and chemical treatments; the characterization was made by FTIR and SEM. However, nanocellulose was used to manufacture flexible membranes.

Nanocell42: Macroalgae from Antarctica as raw material for Nanocellulose scaffolds.

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The presence of cellulosic material in the cell wall of algae has been known since the 19th century. It consists of the insoluble fraction after the extraction of alginates from brown algae. However, the use of algal biomass for the production of cellulose and nanocellulose was incipient until the middle of 2015. In this work we use of the antarctic macroalgae Cystosphaera jacquinotii to produce nanocellulose scaffolds. For this, biomass was submitted to an alkali treatment with 5% NaOH and subsequent bleaching with 0.1 molar $NaClO_2$ and pH 4.0. The suspension, after washing and neutralization, was sonicated and freeze dried, resulting in a like-sponge structure. The crystallinity evaluated by XRD was 71.2% and the morphology evaluated by SEM-FEG revealed that the material is consisted of nanofibers with a diameter of approximately 32 nm. Cell viability ratio against fibroblasts was tested, revealing that the structure obtained is non-toxic and can be used as scaffold for tissue engineering.

Nanocell43: Optimization of Nanocellulose isolation process by combined methods.

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Nanocelluloses (NCs) have unique properties that make them an excellent choice for many applications. Different methodologies for obtaining NCs have been studied, aiming the development of environmentally friendly processes with good efficiency in size reduction and that can be applied in high-scale. In this work, NCs were isolated with combined methods: mechanical grinding and high-intensity ultrasound, with time variation. The ball mill was performed for 1, 2, 3 and 4h; and the ultrasound was performed for 10, 20 and 30 min for all the ball milled samples. The NCs were characterized by crystallinity (Fourier transform infrared spectroscopy and X-ray diffraction) and morphology (scanning electron microscope with field emission). Longer milling times (3 and 4h) resulted in a crystallinity loss due to friction and shear forces during the ball mill, which is undesirable. The ideal time was 2 h of milling, resulting in smaller particle sizes and higher crystallinity. To decrease the average sizes the ultrasound was associated; 20 min was the time that presented smaller dimensions (without significant variations of crystallinity) and better dispersion of the particles in solution.

Nanocell44: Characterization of Nanostructured cellulose extracted from the sugarcane bagasse aiming application in polymeric composites.

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There has been an increasing interest to use raw materials from renewable sources in nanometer scale due its technical features. Nanostructured cellulose (NC) presents a good balance between mechanical and environmental properties, which is an interesting alternative for several applications. In this work, NC was extracted from the sugarcane bagasse by the high intensity ultra-sonification (HIUS) process. The atomic force microscopy showed a mixture of structures in nanometric and micrometric dimensions, and a whiskers morphology with average diameter and length of 142 and 25 nm, respectively. The HIUS methodology adopted was not efficient in removing lignin and hemicellulose of the sonicated fibers, verified by thermogravimetric analysis and Fourier transform infrared spectroscopy. However, the sonicated fibers presented a 2 % increase in thermal stability and 11 % decrease in index crystallinity, compared to the starting fibers. Thus, the CN properties allow its incorporation in polymeric composites such as, thermoplastic starch composites, aiming their reinforcements and properties increase.

Nanocell45: Application of nanocellulose in membranes for adsorption of contaminants.

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Recent advances in nanoengineering suggest that many of the current problems involving water quality could be greatly diminished by using nanoparticles. Nanocelluloses (NCs) exhibited good adsorption efficiency of the contaminants when their surface was modified (the greater active sites interact with metallic species from dyes derivatives from industrial effluents). In this work, NCs were prepared through the mechanical process and phosphorylated. The NCs were characterized by Dynamic Light Scattering, Fourier-transform infrared spectroscopy (FTIR), and Degree of Substitution. The membranes, without and with NCs, were prepared by phase inversion, using poly(butylene adipate-co-terephthalate) (PBAT) and characterized by scanning electron microscopy, FTIR and adsorption efficiency. The results showed a reasonable degree of substitution (0.8) and sorption efficiency. The high-surface-area of the nanomaterials drove the removal efficiency. The nanoparticles were added into PBAT improved the adsorption capacity of the system of metallic ions on and stability in terms of increased regeneration cycles in single metal solutions.

Nanocell46: Nanocellulose from agroindustrial waste for carbon nanotube dispersing agent.

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Owing the large volume of banana in Brazil, there is a high generation of waste, as well as barks and stalks, which, in turn, have great potential for scientific technical exploitation. These stalks and banana peels are rich in polysaccharides with potential applications as raw material for the production of nanocellulose. In this work we used banana peels stalks to produce nanocellulose whiskers to replace surfactants in the dispersion of carbon nanotubes, which excludes the need for their functionalization. Most of known applications of carbon nanotubes requires a well dispersed solution of nanotubes, hence the best way to disperse these nanotubes are the use of highly concentrated acid functionalization. The usage of nanocellulose as a surfactant can be useful when seeking waterbased, efficient, and green pathways for their preparation, making the process less aggressive to the material and to the environment. To obtain the cellulose, the pulp was chemically treated, then, was exposed to acid hydrolysis in order to obtain nanocellulose. Preliminary tests using nanocellulose with carbon nanotubes indicated that its application as a dispersing agent is rather promising.