

TAPPI International Conference on Nanotechnology for Renewable Materials 2016

Genoble, France
14 - 16 June 2016

Volume 1 of 2

ISBN: 978-1-5108-2800-1

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2016) by the TAPPI Press
All rights reserved.

Printed by Curran Associates, Inc. (2016)
For permission requests, please contact the TAPPI Press



at the address below.

TAPPI Press
15 Technology Parkway South
Peachtree Corners, Georgia 30092

Phone: (800) 332-8686
Fax: (770) 446-6947

memberconnection@tappi.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

The Pulp and Paper Industry and the Bioeconomy: Shifting Towards the Post-Petroleum Economy	1
<i>N/A</i>	
Quantitative Analysis of Market Data and Trends for Cellulose Nanomaterials	18
<i>M. Bilodeau, J. Cowie</i>	
Nanocellulose: Technology, Applications and Markets	30
<i>J. Miller</i>	
Competitive Position of Nanocellulose in the Material Landscape	40
<i>P. Vasara, J. Kautto, J. Kuhlman</i>	
Economics of CNC Production	49
<i>C. Houtman, K. Nelson, T. Bilek, J. Cowie</i>	
Solvent Resistance of TEMPO-Treated Nanofibrillated Cellulose Film for Flexible Electronics	62
<i>Z. Fang, Y. Kuang, G. Chen</i>	
Roll-to-Roll Nanoimprinting of CNF Film	73
<i>T. Makela</i>	
Ultrasonic Spray Coating as a Versatile Technique for the Large Area Deposition of Functional Nanoparticles	84
<i>J. Stryckers, W. Deferme, J. Drijkonngen</i>	
Polarized Light Microscopy of Cellulose Nanocrystal Suspensions and Films	95
<i>D.G. Gray</i>	
Cooperative Ordering of Cellulose Nanocrystals in a Magnetic Field	105
<i>E. Cranston, K. De France, K. Yager, T. Hoare</i>	
Easy Production of Cellulose Nanofibrils from Corn Stalk by a Conventional High Speed Blender	112
<i>S. Boufi</i>	
Systematic Production of High Quality and Low Cost Cellulose Nanofibers and their Potential Applications	121
<i>N. Amiralian, P.K. Annamalai, D.J. Martin</i>	
Study of a Different Approach to Obtain Nanocellulose from Coconut Fibers	134
<i>D.M. Nascimento, Y.L. Nunes, J.P. Morais, M.S. Filho, M.C. Figueiredo, M.F. Rosa</i>	
The Intersection of Natural Fungal Proteins, Biomass-Derived Products and Semiconducting Polymers: A Sustainable Way to Advance Functional Materials and Devices	144
<i>C. Rosu, B. Risteen, P.S. Russo, E. Reichmanis</i>	
Screen Printing of Cellulose Nanofibrils-Silver Nanowires Inks for Transparent Conductive Electrodes	154
<i>F. Hoeng, A. Denneulin, N. Reverdy-Bruas, J. Bras</i>	
Colloidal Interactions Between Hydrophobic Nanoparticles and Starch	166
<i>F. Iselau</i>	
Cellulose Nanocrystals to Stabilize Versatile O/W and W/W Pickering Emulsions	172
<i>I. Capron, K. Peddireddy, F. Cherhal, L. Benyahia, T. Nicolai</i>	
Nanocellulose-Water Interactions: A Necessary Evil?	182
<i>M. Vuoriluoto, M. Lundahl, M. Ago, M. Borghei, G. Cunha, H. Orelma, I. Filpponen, O.J. Rojas</i>	
TEMPO Oxidation of Bauer McNett Thermomechanical Pulp Fractions for Nanocellulose Fibers Production	196
<i>D. Myja, E. Loranger, E. Leonard, C. Len, R. Lanouette</i>	
Thermomechanical Pulp: A Possible Raw Material for Production of Individualised Microfibrils?	206
<i>F.W. Brodin, O. Eriksen</i>	
Nanocellulose-Based Paper Li-Batteries	216
<i>S.Y. Lee</i>	
Hybrid Nanoporous Pigment - Cellulose Nanomaterial Composites for Printed Energy Storage Applications	239
<i>K. Torvinen</i>	
Free-Standing Electrospun Carbon Network from Lignin as a Conductive Electrode for High-Performance Supercapacitors	249
<i>M. Ago, M. Borghei, O.J. Rojas</i>	

The Role of Residual Lignin on Nanofibrillate Cellulose and Materials Made Thereof	258
<i>M.S. Peresin, E. Rojo, O.J. Rojas</i>	
Physico-Chemical investigation of Cellulose Nanomaterials using NMR Liquid Relaxation	270
<i>D. Fairhurst, S. Race</i>	
Formation of Novel Bionanomaterials Via Self-Assembly of Protein Corona on Colloidal Lignin Particles	285
<i>T. Leskinen</i>	
Cellulose Nanocrystal Process & Production Improvements	296
<i>J. Lockhard</i>	
Production of Cellulose Nanocrystals Directly from Wood	311
<i>U. Agarwal</i>	
Suitability of Commercial Enzymes for Integrated Production of Cellulose Nanocrystals & Industrial Sugars	324
<i>G. Siqueira, R. Nardi, V. Arantes</i>	
Applications of TEMPO-Oxidized Cellulose Nanofibrils to Optical and Oxygen-Barrier Films and ULPA-Grade Air-Filters	336
<i>A. Isogai</i>	
Nanocellulose-Based Composites for Conservation and Restoration of Cultural Heritage on Paper: Comparative Studies Between Traditional and Innovative Methods	348
<i>F.V. Pereira</i>	
Surface Modification of TEMPO-Oxidized Cellulose Nanofibrils by Amine-Terminated Polyethylene Glycol for Thermal Improvement	366
<i>N. Lavoine</i>	
Novel Multifunctional Nano Pigments for Papermaking and Coating	374
<i>M. Durand, C.P. Klass</i>	
Cellulose-Cellulose Bonding in CNC Aerogels	387
<i>C. Buesch, M.S. Mohammadi, P. Eschbach, J. Simonsen</i>	
New Commercial Process for Production of Mineral/Microfibrillated Cellulose Composite Materials Exhibits Great Flexibility	406
<i>D. Skuse, P. Svending, J. Phipps, T. Larson, J. Husband, T. Selina</i>	
Cellulose Filaments: Discovery by FPInnovations of a Novel Strengthening Agent	417
<i>X. Hua, M. Laleg, T. Owston</i>	
Produce CNF Film Using Slot Die Coating Method	429
<i>R. Gong</i>	
Calcium Carbonate Pigment Hydrocolloid Hybrid Enabling Bonding with Micro Nanofibrillated Cellulose	441
<i>R. Bollstrom, C. Ridgway, M. Schenker, P. Gane</i>	
Reinforcement of Middle Ply of Board with HefCel	458
<i>J. Lehmonen, E. Hytonen, H. Kangas, P. Lahtinen, J. Pere</i>	
The Application of CNF to Improve Paper Properties	468
<i>D. Cowles</i>	
Chemical-Free Pulping with GreenBox++TM Nanocellulose for Lightweight Packaging	484
<i>K. Nelson</i>	
Dry-Jet Spinning of Cellulose Nanofiber (CNF) Filaments onto a Non-Adhering Surface	495
<i>Y. Shen, H. Orelma, A. Sneck, K. Kataja, P. Qvintus, A. Suurnakki, A. Harlin</i>	

VOLUME 2

Polyethylene Cellulose Nanofibrils Nanocomposites	503
<i>A.D.A. Lucas</i>	
High Volume Composite Opportunities for Big Area Additive Bio-Manufacturing	512
<i>S. Ozcan</i>	
CF Dispersion and Drying	523
<i>Y. Ben</i>	
An EH&S Approach for Commercialization of Novel Forms of Nanocellulose	541
<i>K. Ong, J. Ede, J.A. Shatkin, K. Nelson</i>	
Improving Multilayer Packaging Performance with CNF Barrier Layer	551
<i>J. Vartiainen</i>	
Dispersion of Layered Silicates in Composites of Poly(Vinyl Alcohol) and Microfibrillated Cellulose for Water Vapour Barrier Improvement	567
<i>S. Raynaud, F. Clegg, A. Dufresne, D. Guerin</i>	

Effect of Humidity on the Permeability of Alcohols in Hydroxypropyl Xylan Films	587
<i>F. Bayati, Y. Boluk, P. Choi</i>	
Cellulose Nanocrystal Reinforced Oxidized Natural Rubber Nanocomposites	599
<i>M. Mariano</i>	
Roll-to-Roll Processed Nanocellulose Coatings for Barriers Applications	615
<i>V. Kumar, A. Elfving, H. Koivula, D. Bousfield, M. Toivakka</i>	
Melt Extrusion of Adsorbed Cellulose Nanocrystals with Polyethylene: A Small Angle X-Ray Scattering Characterizations (SAXS)	624
<i>M. Nagalakshmaiah, N. Elkissi, A. Dufresne</i>	
Surface Modification of Cellulose Nanocrystals (CNCs) with Diazonium Salts and their Application in Nanocomposites	633
<i>R. Du, G. Kaufman, M. McDermott</i>	
Cleaner and Scalable Processing of Cellulose Nanocrystal Reinforced Thermoplastic Polyurethane Nanocomposites	644
<i>K.N.M. Amin, N. Amiralian, P.K. Annamalai, G. Edwards, C. Chaleat, D. Martin</i>	
Studies of PAN/CNC and PAN/Lignin Nanocomposites	658
<i>J. Luo</i>	
Cellulose Nanocrystals as New Bio Based Coating Layer for Improving Fiber-Based Barrier Properties	672
<i>E. Gicquel, C. Martin, J. Bras</i>	
Improved Properties for Packaging Materials by Nanoscale Surface Modification and ALD Barrier Coating	684
<i>J. Lahti</i>	
Anisotropic Cellulose Nanocrystal Hydrogel Composite Scaffolds for Promoting Directed Cell Growth	707
<i>K. De France</i>	
Low Cost Drying Method to Obtain Redispersable Nanocellulose Powders	714
<i>K. Nelson</i>	
Looking Beyond the Round Bottom Flask: The Path to Commercial Scale for Cellulose Nano-Crystals	724
<i>A.W. Rudie, C. Houtman</i>	
Complete Nanofibrillation of Cellulose Prepared by Phosphoric Acid Esterification	736
<i>G. Banzashi</i>	
Carboxylated and Thermal Stable CNC and CNF with Tailored Morphologies Produced Using Fully Recyclable Solid Di-Carboxylic Acids	746
<i>J.Y. Zhu</i>	
Risk Assessment of Polymer Composites Containing Cellulose Nanofibrils (CNF)	759
<i>H. Kangas</i>	
Progress in Understanding Worker Exposure and Risk for Cellulose Nanomaterials	769
<i>C.L. Geraci, A.C. Eastlake, K.L. Dunn</i>	
Establishing the Safety of Cellulose Nanomaterials Across the Product Life Cycle	782
<i>J.A. Shatkin</i>	
Functional Nanocomposite Materials Based on Nanocellulose and Metallic Nanoparticles (Cu and Pt): Study of the Conductive and Catalytic Properties	793
<i>R. Pinto, A.J.D. Silvestre, M. Simoes, P. Marques, C.S.R. Freire</i>	
Cellulose Nanofibrils Aqueous Modification with Different Alkoxysilanes: Influence of Amino Presence on Surface Mechanisms and Properties	807
<i>C. Reverdy, N. Belgacem, M.C.B. Salon, J. Bras</i>	
Structure and Rheological Behavior of CNC Dispersions Probed by Local Birefringence and In-Situ Rheo-Saxs	820
<i>F. Pignon, A. De Geyer, E. Gicquel, C. Rey, N. Hengl, B. Jean, J. Bras, S. Prevost</i>	
Characterization of Stimulus Responsive Cellulose Nanofibril-Based Hydrogels for Drug Release	839
<i>B.D. Park, N. Masruchin, V. Causin</i>	
Development of Functional Cellulose Nanofiber Coating for Preserving Pre- and Post-Harvest Fruit Quality and Thermally Processed Fruits	851
<i>J. Jung, Y. Zhao, J. Simonsen</i>	
Cellulose Nanofibril Addition to Paper for Improvement of Barrier Properties	871
<i>K. Fein</i>	
Challenges of Cellulose Nanocrystal (CNC) Metrology	881
<i>Z.J. Jakubek</i>	
Characterization Dielectric Properties and Moisture Uptake of Cellulose Nanocrystals Using Noncontact Microwave Cavity	888
<i>J. Obrzut, C. Emiroglu, B. Pazmino, J. Douglas, J. Gilman</i>	

Cellulose Nanocrystals: Benchmarking and Characterization	900
<i>M. Reid, M. Villalobos, E. Cranston</i>	
Rheological Investigation of Pigmented Micro-Nano-Fibrillated Cellulose (MNFC) Suspensions	912
<i>M. Schenker, J. Schoelkopf, P. Mangin, P. Gane</i>	
Micro-Structure of Coating Color Influenced by CMC and CNFs and its Effect on Drying and Structure of Coating Layer	921
<i>K. Oh, J.H. Lee, H.J. Youn, H.L. Lee</i>	
How Nanocellulose Modifies the Rheological Behavior of Slurries in Coating Colors?	932
<i>C. Martin, E. N'Guindza-Okouyi</i>	
Can Redispersible Low-Charged Nanofibrillated Cellulose be Produced by the Addition of Carboxymethyl Cellulose Prior to its Drying?	939
<i>A. Naderi, T. Lindstrom, J. Sundstrom, G. Flodberg</i>	
Effect of Combined Sulfuric and Hydrochloric Acid Hydrolysis on the Morphology and Properties of Bacterial Cellulose Nanocrystals	954
<i>M.D.F. Rosa</i>	
Single Pot Hydrophobization of CNCs from Water and its Potential for Polymer Nanocomposites	965
<i>J.P. Youngblood, S. Peng, Y. Yoo, R. Moon</i>	
Grafting Low Molecular Weight Polyethylene onto Cellulose Nanocrystal Surfaces Via Esterification	978
<i>M. El-Bakkari, M. McDermott, Y. Boluk</i>	
Cellulose Nanoparticles as Modifiers for Rheological and Fluid Loss in Water-Based Drilling Fluids	992
<i>M. Li, Q. Wu</i>	
Author Index	