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GUEST EDITORIAL

Special issue on "Nanocellulose characterization, production and use"

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The world population is expected to exceed 9 billion by 2050. Such exponential growth, along with increasing consumerist trends and unprecedented levels of environmental impact, is happening while the supply of natural resources for our energy needs is either constant or declining. This calls for deep changes in our lifestyle and a search for disruptive innovation in the energy sector, seeking processes that are more efficient, sustainable, and environmentally benign. Also, by increasing awareness about sensitive issues such as resource constraints, societal values, impact on the economics, governance style and environmental concerns, actions may be facilitated to boost the technological development for the production and use of sustainable biofuels, greener materials and bio-based products.

Fossil-based resources have supported our industrial development for nearly one century. However, their widespread exploitation causes unprecedented consequences for natural ecosystems, food supplies, biodiversity and climate change. Of course, such effects would have been less impacting if efficient systems of production, fractionation, conversion, recycling and disposal were implemented, but these strategies are still lacking for technical, economic and political reasons. Hence, producers, consumers, entrepreneurs, investors, opinion makers and government should accept their role in promoting a much-desired transition from a linear economy to a bio-based circular economy, as stated in the Bioeconomy Strategy by the European Commission.

In the last century, many efforts have been paid to the development of environmentally friendly materials for a wide range of applications. Among these materials, cellulose deserves special mention due to its abundance, light weight, recyclability, biodegradability, mechanical properties and many other characteristics. However, although abundant, forests and croplands have a finite capacity to supply cellulosic resources, a fact that is forcing society to explore optimized and improved extraction processes in order to obtain maximum efficiency in terms of natural resource exploitation.

Nanocellulose has become a topic of great interest and innovation in recent years. Since the development of its precursor in the mid-80s by Turbak and Snyder, production has increased significantly, moving from laboratory to large scale. In fact, a recent report by Future Markets declared that the global production of nanocellulose increased from 17 to 400 tons per year from 2010 to 2015. Also, in a conservative scenario,

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nanocellulose production is estimated to reach 10,500 tons per year in 2025. Another clear example of the growing interest in nanocellulose is the scientific production in high-impact journals, which is experiencing an exponential growth. Nanocellulose, either in the form of cellulose nanofibers, cellulose nanocrystals or even bacterial cellulose, has been reported to provide technical and economic advantages to different sectors such as pulp and paper, cosmetics, water purification, composites, rheology modifiers, biomedicine, food technology and printed electronics, among others. The almost unlimited variety of application of these nanomaterials is due to their outstanding chemical, physical and mechanical properties. One of such properties is their ability to increase the resistance of papers and cardboard, producing lighter and equally resistant materials with extended shelf-life, performance and recyclability. On the basis of these, we are convinced that nanocellulose will have an important role in the achievement of the Sustainable Development Goals, as well as in the transition from a linear economy to a circular bioeconomy.

This Special Issue of Cellulose is being published as both a Virtual Issue and a normal print issue. It arises from the Workshop entitled "Advances in the production and application of nanocellulose", which was held during the "2nd International Workshop on Biorefinery of Lignocellulosic Materials" (WBLCM 2019) in Córdoba, Spain (June 4–7th, 2019). The Workshop was organized by the NANOCELIA Network with the support of the University of Córdoba and the Ibero-American Program on Science and Technology for Development (CYTED), an agency that promotes cooperation in science, technology and innovation for the harmonious development of Ibero-American countries. The NANOCELIA Network has been created to promote the dissemination of knowledge and the support of industrial SMEs in Latin America that are dedicated to nanofibrillated cellulose production processes and to the development of systems for its application in paper products and composites. Currently, 22 research groups from 10 countries are participating in the NANOCELIA Network with 153 professionals from different thematic areas related to the use of agricultural and forestry biomass, the development of products with high added value, knowledge and experience in nanotechnology and the applications of these products in a variety of industrial sectors.

The special issue contains 25 papers from different international research teams, covering the production, characterization, and application of nanocellulose in different sectors. Unfortunately, eight of these papers were inadvertently already printed in earlier issues and are not reprinted here. (All 25 are collected in a Virtual Issue, https://www.springer.com/journal/10570/updates/18360262.) A listing of these papers is at the end of this Editorial. A total of 121 authors from 17 countries have contributed to this special issue, and these were distributed in the following way: Argentina (4), Brazil (31), Canada (7), Chile (5), Colombia (16), Finland (7), France (3), India (2), Italy (1), Latvia (1), Mexico (1), Portugal (17), Russia (1), Spain (15), Sweden (8), The Netherlands (1), and United Kingdom (1). These papers were submitted by members of the NANOCELIA Network and a few invited collaborators from both academia and industry, to whom we are grateful for their invaluable contribution.

It is now time to thank our supporters, without whom this publication would have never been possible. We thank all authors for their time and effort to meet the deadlines, as well as to all external reviewers for their timely, rigorous and professional work. More importantly, we are more than thankful to Dr. Alfred French, the competent Editor-in-Chief for Cellulose, who embraced our project from its very beginning and helped us enormously with the quality of his final revision. Finally, the professional support of Cellulose's editorial team is greatly acknowledged, particularly for their continuous and prompt help in handling manuscripts through Editorial Manager.

With this collection organized as both a Virtual Issue and a print issue, we hope to have reached our goal in disseminating the major findings that have been achieved within the NANOCELIA Network and contributed to the science involved in this very important area of research, development and innovation.

Guest Editors

María Evangelina Vallejos
Marc Delgado-Aguilar

Lead Guest Editor
Luiz Pereira Ramos

Previously published papers from this Special Issue

Pirich CL, Picheth GF, Fontes AM et al (2020) Disruptive enzyme-based strategies to isolate nanocelluloses: a review. Cellulose 27:5457–5475. https://doi.org/10.1007/s10570-020-03185-8

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