

Book review

Ionic liquids in the biorefinery concept: challenges and perspectives

DOI 10.1515/gps-2016-0027

Rafal Bogel-Lukasik (Ed.)

The Royal Society of Chemistry, 2016

RSC Green Chemistry series no. 36

Hardcover, 297 pp.

Print ISBN: 978-1-84973-976-4

PDF eISBN: 978-1-78262-259-8

EPUB eISBN: 978-1-78262-724-1

Rapid and continuous growth in world population results in an overall rise in global energy demands increasing the ongoing pressure on current production and the supply chain. As fossil fuels are no longer considered renewable, the need to find alternative sustainable feedstocks for obtaining energy, chemicals, and materials is becoming crucial. In recent years, there is a growing interest in utilizing biomass in production of bio-fuels and valuable chemicals, not mainly to make the same, but to replace current products obtained from fossil fuels. *Ionic liquids in the biorefinery concept*, edited by Rafal Bogel-Lukasik, provides a comprehensive overview of ionic liquids application in biomass processing in biorefineries, while also outlining the need for following the principles of green chemistry. Current achievements, challenges, and the potential of ionic liquids utilization in the biorefineries concept have been addressed.

The book is divided into 10 chapters – chapter 1 provides understanding of the term biorefinery and concept of green chemistry. Detailed historical overview of biomass utilization, from first tar and coal biorefineries, saw-mill, paper and pulp industry to modern technology of biomass processing has been given. Use of ionic liquids as solvents for biomass pretreatment is discussed in chapter 2. Ionic liquids have shown high promise in this area. The importance of determining parameters that affects successful application of ionic liquids, such as biomass type and loading, water content, temperature and heat source have been described.

In chapter 3 the chemistry of ionic liquids in biomass pretreatment has been described. Techno-economic analysis showed the importance of ionic liquids recycling in the

biomass pretreatment process. Several other key factors have been identified. Chapter 4 emphasizes the importance of carbohydrate depolymerization by hydrolysis in order to obtain fermentable sugars. Here, the focus is on challenges and different application types of ionic liquids in biomass hydrolysis.

The utilization of ionic liquids for selective extraction of valuable chemicals from different feedstock types, such as plant biomass, seeds, and food waste is described in chapter 5. Phenolic compounds, essential oils, proteins and polysaccharides are only some of the valuable chemicals that have been successfully extracted with ionic liquids due to our ability to tailor their extraction selectivity. Choosing the appropriate biomass feedstocks and correct extraction methods affects the design of task specific ionic liquids. Chapter 6 focuses on the toxicity and biodegradation of ionic liquids. In this chapter the authors emphasize the need for more intensive research towards development of new environmentally friendly, third and fourth generation of ionic liquids.

Application of ionic liquids in the synthesis of 5-hydroxymethylfurfural is discussed in chapter 7. HMF is an intermediate for production of a wide variety of valuable chemicals and ionic liquids have broadened the selection of feedstocks applicable for its synthesis. Purification of added-value compounds from biomass using solid-phase and liquid phase extraction techniques by utilizing ionic liquids is discussed in chapter 8.

In chapter 10 the authors present and discuss a SWOT analysis of using liquids in an integrated biorefinery. Technological approaches that need to be developed in order to overcome the barriers are reviewed. Some of the ionic liquids strengths recognized are reduction of waste generation, reduction of the number of processing steps and the higher reaction or extraction selectivity. Some of the recognized weaknesses are high ionic liquid cost, ion leaching and side reactions.

The authors of this book have successfully provided an excellent and detailed overview of recent achievements made in the field of biomass processing by the use of ionic liquids. Information presented in the chapters shows the importance and vast possibilities in application of ionic

liquids in the biorefinery concept. Our ability to change the physical and chemical properties of ionic liquids by changing their cation or anion structures opens new areas of their potential utilization for sustainable, economical, and green chemistry based biorefineries. I would recommend this book to researchers and students that work or plan to venture in this field.

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