Preface

Lignin is the second most abundant natural renewable polymer after cellulose. Natural lignin is a phenolic polymer formed by radical coupling polymerization of three monolignols, and it has amorphous macromolecular structure. Lignin is currently produced as waste or by-product streams from paper pulping and lignocellulosic ethanol processes, with limited applications for heat and power generation. Many studies have been conducted on value-added utilization of lignin. The availability, the presence of various functional groups (aromatic and hydroxyl) on lignin, lypohydrophilic structure, biodegradability, antioxidant and reinforcing capability make it a potential candidate for the production of bioaromatic chemicals (such as vanillin and phenols), bio-based polymeric materials (resins and polymers), and carbon fibers or for consumption as reinforcement fillers in thermoplastic polymers or dispersants. The reactivity of lignin could be enhanced through some chemical modifications and thermochemical depolymerization processes. Thus, lignin has great promise for production of biochemicals and biopolymers.

Although there are some books on the lignin chemistry and properties, the unique feature of this book is that it focuses on utilization of modified (e.g., via depolymerization and liquefaction) or non-modified lignins for high-value bio-based chemicals and materials.

This book consists of eight chapters, as detailed below. Chapter 1 introduces the fundamentals of chemical structure and properties of lignin and various delignification processes to extract lignin from lignocellulosic biomasses. Chapter 2 describes fast pyrolysis of lignin, the lignin pyrolysis mechanism, and the composition of lignin-derived pyrolytic products, as well as the influence of operation parameters and reactor design on the yields and composition of the pyrolytic products from lignin. Chapter 3 overviews depolymerization of lignin through various thermochemical processes including hydrolytic, reductive, and oxidative depolymerization to reduce the molecular weight of lignin with improved reactivity. Chapter 4 focuses on the performance of lignin (modified or non-modified lignin) as a reinforcement filler for thermoplastic polymers as well as its potential as a precursor or a starting material for production of carbon fibers. Chapter 5 describes the application of lignosulfonate as effective surfactants and dispersants in various industries. Chapter 6 presents a comprehensive overview on the production of lignin-based phenol formaldehyde resins, and analyzes the effects of lignin type, synthesis conditions and pre-treatment of lignin on the substitution ratio of lignin and its performance as a wood adhesive for different engineering wood composites. Chapter 7 provides an overview on chemistry, properties and applications of epoxy resin, as well as the production, curing kinetics and physiochemical properties of lignin-based epoxy resins. Chapter 8 presents the potential of lignin as a bioreplacement for polyol in the production of lignin-based PU for various applications including elastomers, coatings/adhesives/sealants, flexible foams, and semirigid or rigid foams.

This book covers a wide range of scientific and technical aspects on utilization of modified (e.g., via depolymerization and liquefaction) or non-modified lignins for high-value bio-based chemicals and materials. It is expected that the text would be of interest to students, researchers, academicians, and industrialists in the areas of valorization of lignin for the production of high-value bio-based chemicals and materials with industrial applications.

London, Canada

Chunbao Xu
Fatemeh Ferdosian

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