

Biomass Conversion to Bio-derived Materials and Their Applications

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Nowadays, fossil fuels still serve as the primary global energy resource. Replacing fossil fuels with renewable sources of energy and developing efficient energy storage technology is an urgent problem to solve. Lignocellulosic biomass has been investigated as a promising alternative for the production of biofuels, chemicals, and materials. In this dissertation, we studied the thermochemical biomass conversion strategies via different pretreatments strategies (e.g. dilute acid, ethanol, tetrahydrofuran, gamma-valerolactone) and genetic modification to overcome the biomass recalcitrance and achieve efficient conversion process. The biomass component structure of lignin and cellulose after thermal treatments were characterized and analyzed.

To further explore the utilization of biomass components, this dissertation also studied the potential applications of nanocellulose-based materials. We involved the chemical cross-linking strategy to form cross-linked nanocellulose-based aerogels with excellent water stability, enhanced mechanical properties, and improved thermal stability. Furthermore, the chemically cross-linked nanocellulose-based aerogels presented the adsorption ability toward cation methylene blue dye, which made it a promising water purification material. Moreover, nanocellulose also could be used as a substrate or binder material for supercapacitors to obtain free-standing and flexible properties, which showed great potential in electrochemical applications.