

Polyurethanes from Lignin: Non-Isocyanate Pathways

Background/Objective

- Potential negative impacts of conventional polyurethane (PU) manufacture have prompted the development of isocyanate-free routes, such as cyclic carbonate–amine polyaddition, to produce non-isocyanate PUs (NIPUs) as safer alternatives. When combined with lignin, NIPUs offer a promising alternative to bio-based urethane materials.

Approach

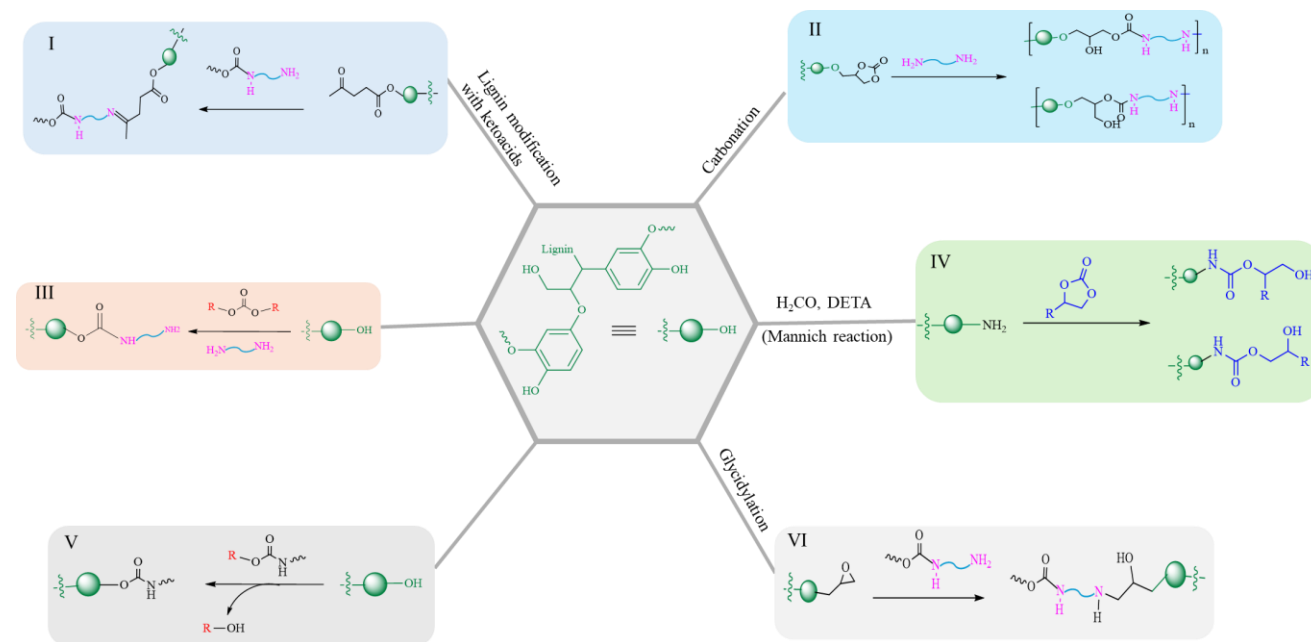
- A comprehensive overview of emerging strategies for lignin valorization in the synthesis of lignin-based NIPUs (LNIPUs) is presented, highlighting their potential as sustainable alternatives.

Results

- The development of LNIPUs synthesized through conventional isocyanate chemistry and how lignin's structural and molecular architecture influence the PU properties is described.
- The fundamental chemical pathways for the development of NIPUs are presented.
- Case studies in the synthesis of LNIPUs, with emphasis given to the potential chemical modifications of lignin that enhance its compatibility with NIPU systems and advantages and limitations associated with the development of LNIPUs, are discussed.

Significance/Impacts

- With continued interdisciplinary research, LNIPUs are poised to move beyond laboratory-scale demonstrations toward commercial applications, contributing to a more sustainable polymer industry.



Key modification techniques for lignin during NIPU synthesis

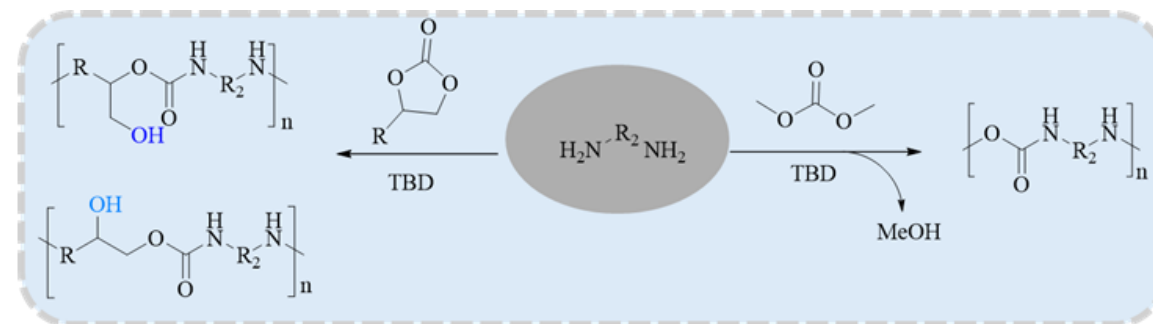


Illustration of carbonate-amine polyaddition reaction - a key reaction employed in NIPU synthesis