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Oxidative depolymerization of lignin using homogeneous transition metal catalysts

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PURPOSE OF THE ABSTRACT

The utilization of platform chemicals sourced from biomass to devise functional products is needed in a future bioeconomy, and this act reflects a main principle of green chemistry. Lignin, the most abundant terrestrial non-carbohydrate biopolymer, is the only large volume renewable feedstock that is comprised of aromatics, offering attractive opportunities toward its valorization. However, this fascinating macromolecule has remained underutilized compared to other biomass feedstocks, as the current large-scale use of lignin is limited to combustion for energy recovery. The conversion of lignin to renewable chemicals thus represents a promising means to enhance the economic viability of existing pulp and paper mills and lignocellulosic biorefinery facilities. In the present study, alkaline oxidative depolymerization of a technical softwood kraft lignin was investigated using various homogeneous transition metal catalysts. The reactions were performed under modest operating conditions using molecular O2 as an environmentally benign primary oxidant. The original lignin (Mw ~5,000 Da) was most effectively depolymerized into low molecular weight products (Mw <826 Da) with Cu-Mn and Cu-V catalysts based on SEC-UV, and yields higher than 40% were obtained for light biooil. Vanillin and vanillic acid were the major products found, as detected by 2D 1H-13C HSQC NMR spectroscopy. Future work will be devoted to the quantification of aromatic monomers present in the light oil fraction and the optimization of reaction parameters. The findings of this study underline the opportunity of sustainably producing high-value aromatic chemicals from industrial lignin streams.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Biomass valorization | Homogeneous catalysis | Lignin depolymerization | Renewable chemicals

BIBLIOGRAPHY