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Evaluation of $\text{Ru}_x\text{Ni}_{1-x}/\text{SBA-15}$ catalysts for depolymerization features of lignin macromolecule into monomeric phenols

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ABSTRACT

The bimetallic catalysts were prepared by a wetness impregnation method with different molar ratios of Ru and Ni ($\text{Ru}_x\text{Ni}_{1-x}$, $x = 0.2, 0.4, 0.6, 0.8$, and 1.0) on mesoporous silica SBA-15. Soda lignin (SL) was directly depolymerized to phenol-rich oil fraction (lignin-oil) over bimetallic catalysts under supercritical ethanol. 2D-HSQC-NMR demonstrated that representative interunit linkages such as β -O-4, β -5, and β - β were considerably degraded during depolymerization process by thermal reaction. Phenol was mainly produced from SL with other phenolic compounds such as guaiacol, 4-ethylphenol, 4-methylguaiacol, 4-ethylguaiacol, and syringol. This study revealed that the chemical properties of lignin-oil were clearly affected by the physicochemical properties of bimetallic catalysts. By increasing the amount of hydrogen binding sites and the acidity of the catalyst, the yields of lignin-oil, total phenols, and phenol increased while that of char decreased. In particular, acidic sites in bimetallic catalysts have a significant effect on the formation of phenol. The yields of total monomeric phenols and phenol were largest with the $\text{Ru}_{0.6}\text{Ni}_{0.4}$ catalyst (12.7 wt%, and 4.7 wt%, respectively).

Keywords: Lignin depolymerization, Bimetallic catalyst, Ruthenium, Nickel, GC/MS,

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