Catalytic depolymerization of kraft lignin in supercritical ethanol over Ru/C and base catalysts

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The depolymerization of kraft lignin to aromatic bio-oil in supercritical ethanol was investigated using a physical mixture of Ru/C and base catalysts. The main objective of this work is to inhibit the bio-oil repolymerization into heavier products and char. Lignin was initially depolymerized into smaller reactive fragments through hydrogenolysis over Ru/C. These reactive compounds were then simultaneously stabilized into monomers through alkylation, guerbet and esterification reaction catalyzed by base catalysts (MgO/ZrO_2). The combined catalyst system demonstrated its effectiveness for the production of bio-oil with high yield and low molecular weight. Under optimal process conditions, the bio-oil yield of 65.13 wt% was obtained, leaving around 10 wt% solid residue (SR) with the lowest molecular weight (Mw) of 718 g/mol and 9.11% monomer yield. Hydrogen addition and base loading effects were also investigated. In hydrogen atmosphere, Mw was significantly lowered, while increasing base loading reduced Mw and increased the monomer yield in bio-oil. Supercritical ethanol was found to be the better solvent compared to 2-propanol in lignin depolymerization.