**Hydrodeoxygenation of lignin derived bio-oil into aromatic hydrocarbons over** **trimetallic catalyst Ni-Cu-Ru/HZSM-5**

LI Bing-shuo, FENG Bi-xuan, WU Kai-ye, YANG Tian-hua\*

(Shenyang Aerospace University, College of Energy and Environment, Key Laboratory of Clean Energy of Liaoning, Shenyang 110136, China)

\*Corresponding author:

thyang@sau.edu.cn (T. Yang)

**Table S1 GC−MS analysis of LDB and UBO**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Compound | Formula | LDB | Blank | UBO |
| HZSM-5 | DeHZSM-5 | Ni-Cu/DeHZSM-5 | Ni-Cu-Ru/DeHZSM-5 |
| 1 | Phenol | C6H6O | 1.75 | 2.04 | 3.68 | 1.23 | 4.15 | 3.16 |
| 2 | 2-methoxyphenol | C7H8O2 | 6.87 | 8.65 | 9.12 | 4.17 | 3.16 | 2.01 |
| 3 | 2,6-dimethoxyphenol | C8H10O3 | 3.63 | 3.03 | 1.38 | 2.53 |  |  |
| 4 | 2-methylphenol | C7H8O | 0.73 | 0.71 | 1.43 |  | 2.62 | 2.14 |
| 5 | 4-methylphenol | C7H8O | 2.55 | 3.86 | 5.64 | 3.11 | 5.29 | 2.07 |
| 6 | 2-ethyl-4-methylphenol | C9H12O | 0.96 | 0.78 | 0.23 | 0.26 | 2.41 | 1.42 |
| 7 | 2-ethylphenol | C8H10O | 0.73 | 1.11 | 0.93 | 0.24 | 2.24 | 1.09 |
| 8 | 2,4-dimethylphenol | C8H10O | 0.79 | 0.84 | 1.23 |  | 1.13 |  |
| 9 | 4-ethylphenol | C8H10O | 8.73 | 8.09 | 9.12 | 7.44 | 6.07 | 5.65 |
| 10 | 2-methoxy-4-methylphenol | C8H10O2 | 8.54 | 8.26 | 7.45 | 8.49 | 4.15 | 2.77 |
| 11 | 2-ethyl-6-methylphenol | C9H12O | 0.89 | 2.72 | 2.64 | 0.63 | 3.73 | 3.09 |
| 12 | 4-ethyl-2-methoxyphenol | C9H12O2 | 10.59 | 11.18 | 12.24 | 8.98 | 5.98 | 3.73 |
| 13 | 2-Methoxy-4-vinylphenol | C9H10O2 |  | 0.79 | 0.49 | 0.27 | 0.98 |  |
| 14 | 2-methyl-5-(1-methylethyl)-phenol | C10H14O | 0.69 | 1.02 | 1.22 | 0.32 | 2.34 | 2.86 |
| 15 | 2-methoxy-4-propylphenol | C10H14O2 | 5.93 | 6.24 | 9.45 | 6.44 | 3.37 | 2.92 |
| 16 | 2-methoxy-4-(1-propenyl)-phenol | C10H12O2 | 3.42 | 3.32 | 4.18 | 3.01 | 3.58 | 1.93 |
| 17 | 2,6-dimethoxy-4-(2-propenyl)-phenol | C11H14O3 |  |  | 0.51 |  | 1.43 | 0.45 |
| 18 | Toluene | C7H8 |  |  |  |  | 1.74 | 2.84 |
| 19 | 1,3-dimethylbenzene | C8H10 |  |  | 0.31 |  | 2.93 | 4.15 |
| 20 | 1-ethyl-2-methylbenzene | C9H12 | 0.23 | 0.24 | 0.26 | 0.30 | 1.29 | 1.68 |
| 21 | 1,2,3-trimethylbenzene | C9H12 | 0.24 | 0.34 | 0.32 | 0.24 | 3.56 | 5.91 |
| 22 | 1-methyl-2-(1-methylethyl)-benzene | C10H14 |  | 0.63 |  |  | 0.61 | 0.91 |
| 23 | 2-ethyl-1,4-dimethylbenzene | C10H14 |  |  | 0.29 |  | 1.23 |  |
| 24 | 1,4-diethyl-2-methylbenzene | C11H16 |  |  |  |  | 1.21 | 5.31 |
| 25 | 1,2,3,4-tetramethylbenzene | C10H14 |  |  | 0.33 |  | 0.76 | 1.23 |
| 26 | Naphthalene | C10H8 | 0.34 |  | 0.41 | 0.27 | 0.83 | 3.69 |
| 27 | 1H-Indene,2,3-dihydro-1,1,5-trimethyl- | C12H16 |  |  |  |  | 0.57 | 0.26 |
| 28 | 1-methylnaphthalene | C11H10 |  |  |  | 0.35 |  |  |
| 29 | 2,6-dimethylnaphthalene | C12H12 |  |  | 0.21 |  | 0.82 | 1.36 |
| 30 | 2,3-dihydro-1,1,3-trimethyl-1H-Indene | C12H16 |  |  |  |  | 0.24 | 0.93 |
| 31 | 1,2,3,4-tetrahydro-2,5,8-trimethylnaphthalene, | C13H18 |  |  |  |  |  | 0.68 |
| 32 | 3,4-Dimethoxytoluene | C9H12O2 | 1.03 | 0.88 | 0.56 | 0.89 | 0.47 |  |
| 33 | 4-ethyl-1,2-dimethoxybenzene | C10H14O2 | 0.67 | 0.62 | 0.61 | 1.20 | 1.38 |  |
| 34 | 1,2,3-trimethoxy-5-methylbenzene | C10H14O3 | 1.51 | 1.4 | 0.98 | 1.43 | 0.51 | 0.22 |
| 35 | Dimethoxymethylphenylsilane | C9H14O2Si | 1.83 | 1.92 | 2.11 | 1.88 | 1.97 | 0.98 |
| 36 | 5-hydroxy-7-methoxy-2-(4-methoxyphenyl)-4H-1-Benzopyran-4-one | C17H14O5 | 0.32 | 0.28 | 0.41 |  | 0.23 | 0.36 |
| 37 | Cholesta-3,5-diene | C27H44 |  |  |  | 0.21 | 0.23 | 0.35 |
| 38 | p-Methoxybenzamide | C8H9NO2 | 0.60 |  | 0.51 |  |  |  |
| 39 | 1,2,4-trimethylcyclohexane | C9H18 |  |  |  |  | 0.49 | 1.78 |
| 40 | 1-Ethyl-3-methylcyclohexane (c,t) | C9H19 |  |  | 0.20 |  |  | 0.22 |
| 41 | decahydro-2,6-dimethylnaphthalene | C12H22 |  |  |  | 0.31 | 0.40 | 1.03 |
| 42 | Cyclododecane | C12H24 | 0.21 | 0.12 | 0.26 |  | 0.39 | 0.84 |
| 43 | Cyclohexane,1-(cyclohexylmethyl)-4-methyl-, cis- | C14H26 |  |  |  |  |  | 0.21 |
| 44 | n-Hexadecane | C16H34 |  | 0.28 | 0.21 |  | 0.36 | 1.24 |
| 45 | Octadecane | C18H38 |  |  |  | 0.23 | 0.28 | 0.67 |
| 46 | n-Heptadecane | C17H36 |  |  | 0.20 |  | 0.41 | 0.92 |
| 47 | Eicosane | C20H42 |  |  |  |  |  | 0.21 |
| 48 | 4'-methoxyacetophenone | C9H10O2 | 1.31 | 0.65 | 0.49 | 1.05 | 0.37 | 0.25 |
| 49 | 1-(4-hydroxy-3-methoxyphenyl)-ethanone | C9H10O3 | 1.45 | 1.15 | 0.98 | 1.51 | 0.35 |  |
| 50 | 1-(4-hydroxy-3-methoxyphenyl)-2-Propanone | C10H12O3 | 0.53 | 0.47 | 0.71 | 0.66 |  | 0.34 |
| 51 | 1-(3,4-dimethoxyphenyl)-ethanone | C10H12O3 | 0.57 | 0.44 |  |  | 0.22 |  |
| 52 | (2,4-dihydroxyphenyl)-methanone | C13H10O4 |  | 0.31 | 0.51 | 0.71 | 0.46 | 0.64 |
| 53 | 7-Methyl-4-azafluorenone,2,4,6-trimethylphenylimine | C22H20N2 | 0.61 |  | 0.83 |  | 0.49 | 0.31 |
| 54 | 4-hydroxy-3-methoxybenzeneaceticacid | C9H10O4 | 1.27 | 1.23 | 0.85 | 1.06 | 0.69 | 0.75 |
| 55 | 4-hydroxy-3-methoxyphenylacetylformic acid | C10H10O5 | 1.61 | 1.43 | 0.57 | 0.98 | 0.64 | 0.46 |
| 56 | 2,2-Diphenylpropionic acid | C15H14O2 | 0.86 | 0.45 | 0.49 | 0.73 | 0.43 | 0.64 |
| 57 | 9-Anthracenecarboxylic acid | C15H10O2 | 0.69 | 0.16 | 0.24 | 0.75 | 0.20 | 0.33 |
| 58 | Oleic acid | C18H34O2 | 0.66 | 0.77 | 0.72 | 0.71 | 0.51 | 0.27 |
| 59 | Dihydrocapsaicin | C18H29NO3 | 0.51 | 0.48 | 0.43 | 0.53 | 0.35 | 0.44 |
| 60 | 3-Hydroxycarbofuran | C12H15NO4 | 0.25 | 0.33 | 0.41 | 0.30 | 0.51 | 0.39 |
| 61 | 7-Methyl-4-azafluorenone,2,4,6-trimethylphenylimine | C22H20N2 | 0.29 | 0.25 | 0.21 | 0.26 | 0.32 | 0.25 |
| 62 | Benzoic acid, 4-hydroxy-3-methoxy-, ethyl ester | C10H12O4 | 1.05 | 0.99 | 0.62 | 0.93 | 0.58 | 0.81 |
| 63 | Benzenepropanoicacid,4-hydroxy-, methyl ester | C10H12O3 | 5.15 | 3.65 | 2.03 | 3.77 | 1.14 | 1.57 |
| 64 | Benzeneaceticacid,4-hydroxy-3-methoxy-, methyl ester | C10H12O4 | 3.27 | 2.43 | 0.81 |  | 0.71 | 1.02 |
| 65 | 1,4-Benzenedicarboxylic acid, ethyl methyl ester | C11H12O4 | 0.18 |  |  | 1.05 | 0.22 |  |
| 66 | Benzenepropanoic acid, ethyl ester | C11H14O2 |  |  | 0.39 | 0.46 | 0.33 | 1.09 |
| 67 | Ethyl(2E)-3-(4-hydroxy-3-methoxyphenyl)-2-propenoate | C12H14O4 | 0.30 | 0.28 | 0.26 | 0.31 |  |  |
| 68 | 1,4-Benzenedicarboxylicacid, diethyl ester | C12H14O4 | 1.28 | 1.09 | 0.48 | 0.84 | 0.85 | 0.26 |
| 69 | Propanoicacid, methyl ester | C12H16O3 | 0.45 |  |  | 1.02 |  |  |
| 70 | Methoxyphenyl) propionic acid ethyl ester | C12H16O3 | 0.38 |  |  |  |  | 0.37 |
| 71 | 2,3-Pentadienoic acid, 2-ethyl-4-phenyl-, ethyl ester | C15H18O2 | 0.68 | 0.41 | 0.25 |  | 0.30 | 0.85 |
| 72 | Pentadecanoic acid, ethyl ester | C17H34O2 | 0.29 |  |  | 0.96 | 0.23 |  |
| 73 | Hexadecanoic acid, ethyl ester | C18H36O2 | 3.13 | 0.97 | 2.99 | 3.51 | 1.94 | 2.01 |
| 74 | Heptadecanoic acid, ethyl ester | C19H38O2 | 0.15 |  |  | 0.34 | 0.51 | 0.29 |
| 75 | Octadecanoic acid, ethyl ester | C20H40O2 | 2.17 | 1.34 | 2.02 | 2.26 | 1.22 | 0.96 |
| 76 | Ethyl Oleate | C20H38O2 | 0.51 | 1.1 | 1.23 |  | 0.49 |  |
| 77 | Nonadecanoic acid, ethyl ester | C21H42O2 | 0.82 | 0.66 | 0.21 | 0.45 |  | 0.24 |
| 78 | Methyl, 2-hydroxy-pentacosanoate | C21H24O2 | 0.83 | 0.89 | 1.04 | 0.68 |  |  |
| 79 | 4-Isopropylbenzenethiol, S-acetyl- | C11H14OS | 0.86 | 0.77 | 0.21 |  | 0.49 | 0.96 |
| 80 | 4-methoxy-alpha-(2-nitrocyclopentyl)-Benzenemethanol | C13H17NO4 | 0.83 | 0.71 | 0.49 | 0.22 | 1.13 | 2.27 |
| 81 | Campesterol | C28H48O | 0.39 | 0.19 | 0.23 | 0.35 | 0.42 | 1.22 |
| 82 | Stigmasterol | C29H48O | 0.43 | 0.4 | 0.37 | 0.40 | 0.84 | 0.97 |
| 83 | beta-Sitosterol | C29H50O | 0.78 | 0.78 | 0.54 | 0.82 |  | 0.94 |