Supplementary Information (SI)

Lignin depolymerisation by nickel supported layered-double hydroxide catalysts

Matthew R. Sturgeon[a,b], Marykate H. O'Brien[a,b], Peter N. Ciesielski[c], Rui Katahira[a], Jacob S. Kruger[a], Stephen C. Chmely[a,‡], Jessica Hamlin[a,b], Kelsey Lawrence[a,b], Glendon B. Hunsinger[a], Thomas D. Foust[a,b], Robert M. Baldwin[a,b], Mary J. Biddy[a,b,*], Gregg T. Beckham[a,b,*]

[a] *National Bioenergy Center, National Renewable Energy Laboratory, Golden, Colorado, USA. Fax: +01-303-384-6363; Tel: +01-303-384-7806; [*]E-mail: gregg.beckham@nrel.gov; mary.biddy@nrel.gov*

[b] *National Advanced Biofuels Consortium, National Renewable Energy Laboratory, Golden, Colorado, USA.*

[c] *Biosciences Center, National Renewable Energy Laboratory, Golden, Colorado, USA.*

Table S1. EDS, ICP, and CHN Elemental Analysis of LDH Catalysts.

	Elemental Composition (Wt %)						
Sample	**Carbon**	**Oxygen**	**Magnesium**	**Aluminum**	**Nickel**	**Hydrogen**	**Nitrogen**
Pre-reaction (EDS)	17.0 ± 4.2	53.3 ± 2.1	17.8 ± 1.9	8.3 ± 1.0	3.0 ± 0.4		
Pre-reaction (ICP)			24.4 ± 0.7	11.6 ± 0.4	3.6 ± 0.1		
Post-reaction (ICP)			22.5 ± 0.2	10.7 ± 0.2	3.3 ± 0.0		
Pre-reaction (CHN)	1.1 ± 0.4					9.0 ± 0.1	0.5 ± 0.2
Post-reaction (CHN)	3.5 ± 0.4					7.2 ± 0.1	0.3 ± 0.2
Catalyst Wash (EDS)	19.5 ± 7.4	52.7 ± 2.8	18.5 ± 3.7	8.8 ± 2.3	3.2 ± 0.6		

EDS was used for elemental mapping and loaded Ni distribution, wt% carbon in this technique is unreliable as samples were loaded onto carbon tape for analysis; therefore, carbon, hydrogen, and nitrogen were analysed via combustion. Catalyst wash refers to the freshly loaded catalyst after washing with hot (100°C) water. Calibrated ICP was used to determine metal content, and CHN was used to determine carbon content in Pre- and Post-reaction catalyst samples.

Table S2. Compounds identified in the GC/MS of CF-lignin and BM-lignin samples treated with 5 wt% Ni/HTC at 270°C for 1h.

Clean Fraction Lignin

Retention time	**Compound**
7.6924	Furfural
10.6863	Furan, 2-methoxy-
11.2863	Succinic acid, 2-methylpent-3-yl propyl ester
11.6274	3-Buten-2-one, 4-(2-furanyl)-
12.1804	Phenol, 4-ethyl-
12.4098	3-Buten-2-one, 4-(2-furanyl)-
12.4627	trans-Furfurylideneacetone
12.6862	Benzofuran, 2,3-dihydro-
13.1038	2-Methoxyresorcinol
13.3215	Phenol, 4-ethyl-2-methoxy-
13.6626	2-Methoxy-4-vinylphenol
14.0273	2-Butanone, 4-(4-methoxyphenyl)-
14.5508	Vanillin
16.0389	Benzene, 1-methoxy-2-pentyl-
16.3507	3-Hexen-1-ol, 6-(2,6,6-trimethyl-1-cyclohexenyl)-4-methyl-, (E)-

Ball Milled lignin

Retention time	**Compound**
9.9039	Phenol
11.545	Phenol, 2-methoxy-
14.1037	Phenol, 2,6-dimethoxy-
14.733	Vanillin
15.3977	Ethanone, 1-(3-hydroxy-4-methoxyphenyl)-
16.774	Benzaldehyde, 4-hydroxy-3,5-dimethoxy-
16.8858	3,5-Dimethoxybenzoic acid
17.5681	Ethanone, 1-(4-hydroxy-3,5-dimethoxyphenyl)-

Figure S1. ICP analysis of pre- and post-reaction solutions

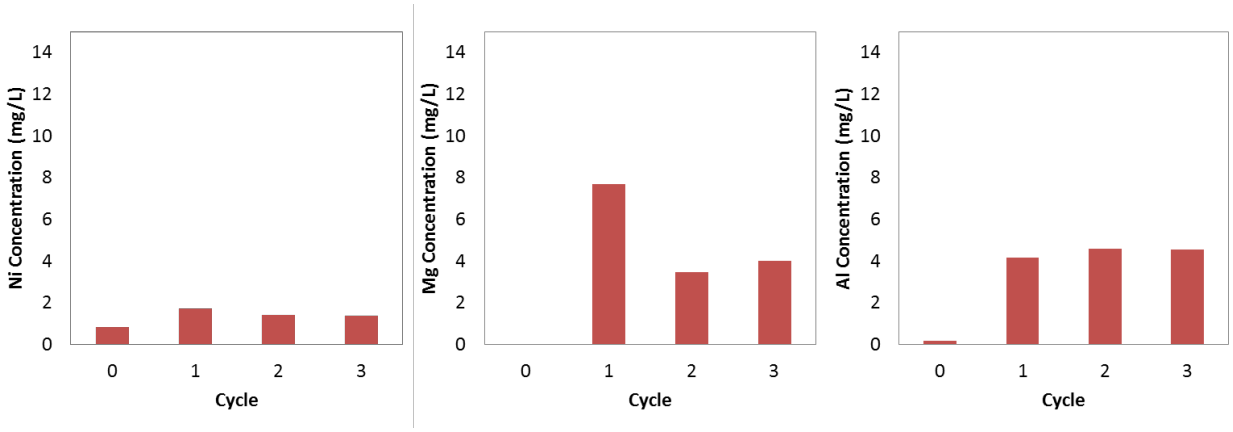

Figure S1 shows the concentrations of Ni, Mg, and Al in PE/MIBK solutions before reaction (Cycle 0) and after one, two, and three reaction cycles, as determined by ICP. Nickel concentrations after reaction are within experimental error of the nickel concentration before reaction, confirming that Ni leaching is negligible.