

Table SI.1. Ash speciation of the blend of 50 wt% clean pine and 50 wt% forest residues used as a feedstock for the biomass CFP experiments in this report (elements analyzed on ash weight basis then calculated and reported as equivalent oxides). Total ash in the sample, heated to 750 °C was 0.77 wt%.

Ashed Basis	wt%
Al ₂ O ₃	1.77
CaO	13.83
Fe ₂ O ₃	0.78
K ₂ O	7.62
MgO	5.2
MnO	1.77
Na ₂ O	0.17
P ₂ O ₅	1.83
SiO ₂	55.48
TiO ₂	0.31
SO ₃	1.53

Table S1.2. Product yields from CFP of 50% forest residue and 50% clean pine blend in the 2FBR system showing system reproducibility. The oil produced from CFP Run 3 was used for co-hydrotreating experiments.

Mass yields	CFP Run 1	CFP Run 2	CFP Run 3
Organic	24%	26%	24%
Aqueous	22%	20%	25%
Condensables	10%	11%	11%
Permanent gases	32%	30%	27%
Water vapor	2%	2%	2%
Char	11%	11%	11%
Coke	2%	2%	2%
Mass balance	102%	103%	102%
Carbon yields			
Organic	34%	36%	37%
Aqueous	2%	1%	2%
Condensable gases	13%	13%	13%
Light gases	31%	28%	25%
Char	16%	18%	18%
Coke	3%	3%	3%
C Balance	100%	99%	97%
O, wt% dry basis	17.1%	16.9%	15.5%

Table SI.3. Composition of condensable light oxygenate stream from 2FBR experiments during CFP Run 3 from Table SI.2.

Product	C yield
Pentane	0.2%
Acetaldehyde	3.4%
Furan	0.5%
Acetone	4.2%
Cyclopentane, -methyl	0.2%
Furan, 2-methyl-	0.6%
Butanal	0.3%
2-Butanone	1.2%
Benzene	0.1%
Furan, 2-ethyl-	0.2%
Furan, 2-5-dimethyl	0.3%
3-Pentanone	0.2%
Toluene	0.1%
Cyclopentanone	0.2%
2-Cyclopenten-1-one	0.1%

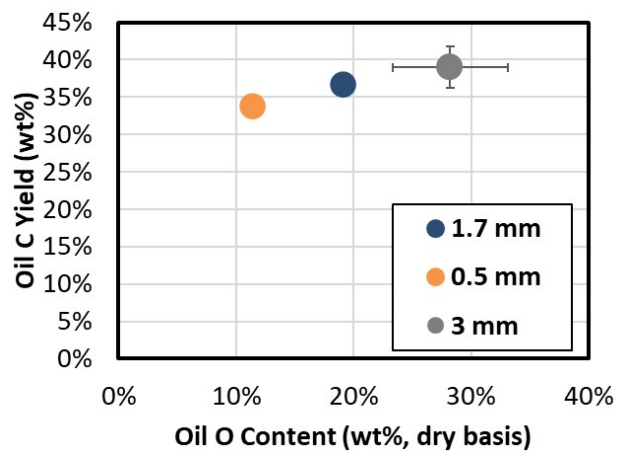


Figure SI.1. Impact of support particles size on carbon yield and oxygen content of CFP oil. Smaller support particle size resulted in lower oxygen content. Feedstock clean pine, cumulative B:C 3.

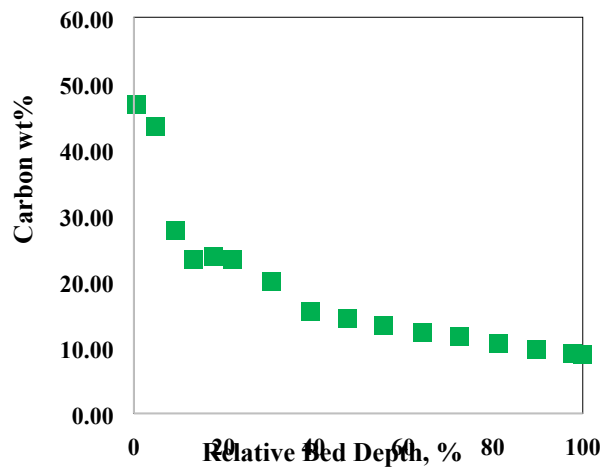


Figure S1.2. Coke content on 0.5%Pt/TiO₂ catalyst samples, as determined by combustion analysis, as a function of normalized bed depth throughout the 100 g catalyst during 13 reaction/regeneration cycles of bench-scale biomass CFP utilizing 50:50 wt% blend of clean pine and forest residues to B:C of 12. Samples analyzed for carbon content were not regenerated prior to analysis.

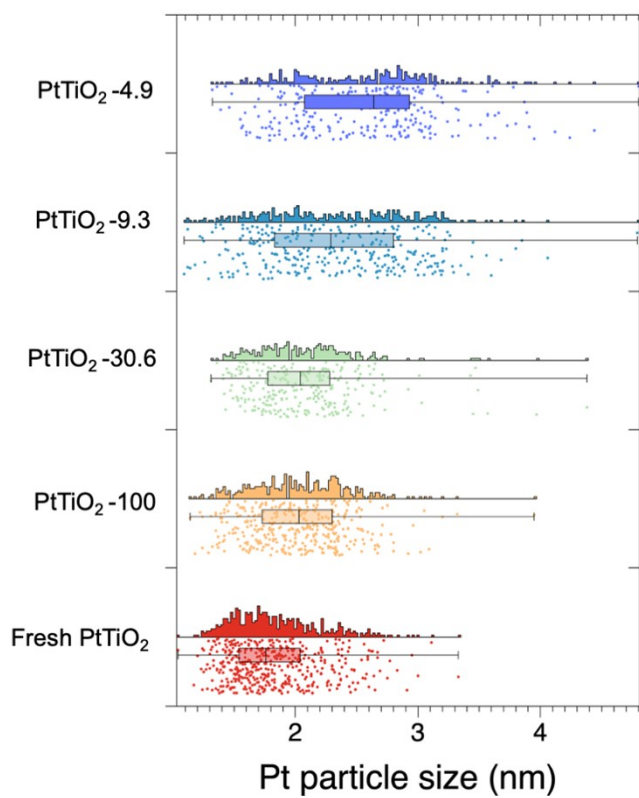


Figure SI.3. Pt particle size measurements from scanning transmission electron microscopy (STEM) for catalysts located at different normalized bed depths. For reference, the Pt particle size measurements for fresh Pt/TiO₂ are also included.

Particle size analysis via HAADF-STEM revealed evidence of Pt sintering, with an average Pt particle size of 2.6 nm from post-reaction samples taken at the leading edge of the bed compared to 1.8 nm for fresh Pt/TiO₂.

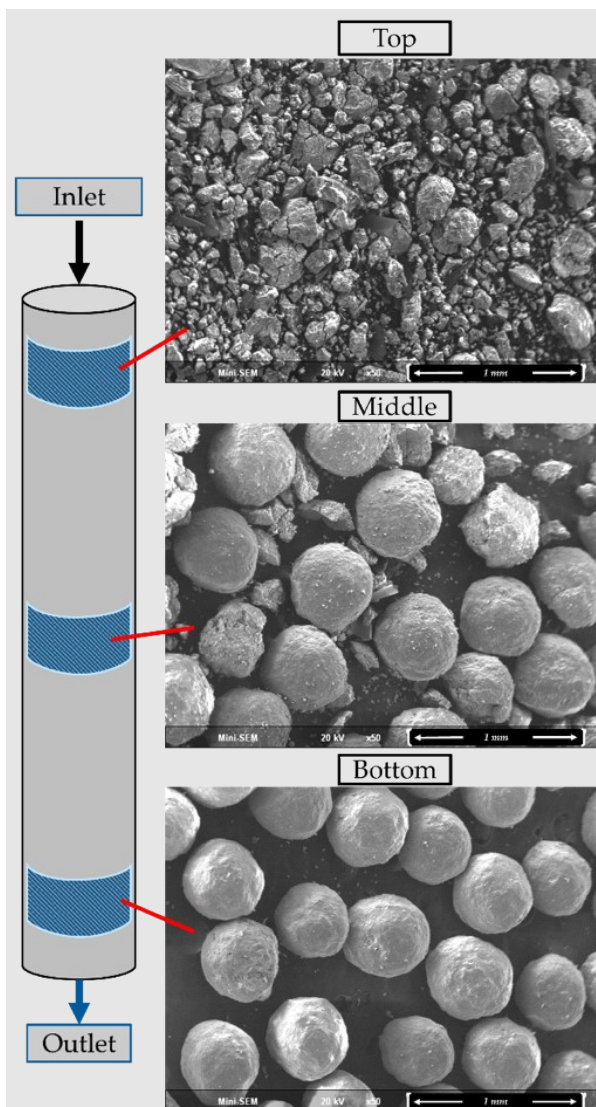


Figure SI.4. Schematic showing representative SEM images of 0.5%Pt/TiO₂ post-reaction samples near the reactor inlet (relative depth of 5%), middle (relative depth 40%), and outlet (relative depth 90%) of the bench-scale fixed bed reactor used for upgrading of biomass pyrolysis vapors following 13 reaction/regeneration cycles.

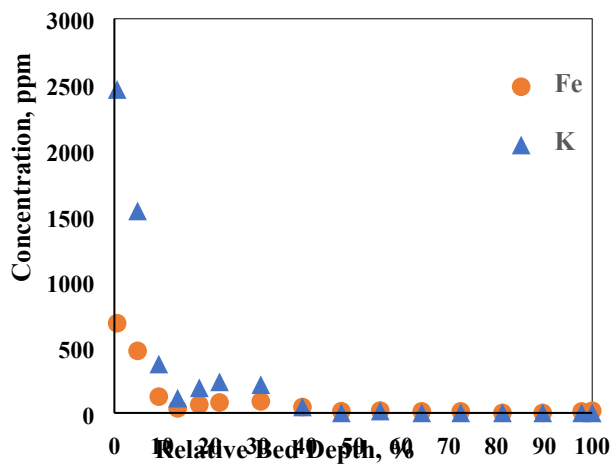


Figure SI.5. Concentrations of inorganic contaminants determined by ICP-OES for post-reaction 0.5%Pt/TiO₂ samples. The 100 g catalyst charge was cumulatively exposed to 7.4 kg biomass during 49 h time on stream and 14 reaction cycles. After the last reaction, the catalyst was unloaded prior to regeneration.

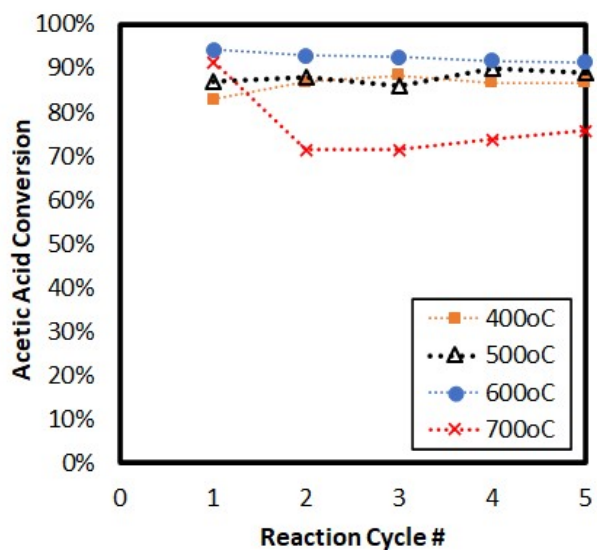


Figure SI.6. Acetic acid conversion during micro-scale experiments over the course of five reaction/regeneration cycles at varying oxidative regeneration conditions. The HDO consisted of total of five (5) one-hour reaction cycles at a WHSV $\sim 20 \text{ h}^{-1}$, separated by a 2-hour oxidation/reduction regeneration protocol, which resulted in a cumulative reactant-to-catalyst mass ratio of 100. The regeneration consisted of heating from the HDO reaction temperature (400 °C) in inert prior to 1 h of oxidation in 1% O_2 at temperatures of 400, 500, 600, or 700 °C, followed by a common reduction at 400 °C in 85% H_2 to activate the catalyst prior to the acetic acid HDO activity measurements.