Supplementary Documents

Glycerol Hydrogenolysis to Produce 1,2-propanediol in Absence of Molecular Hydrogen Using a Pd Promoted Cu/MgO/Al_2O_3 Catalyst

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† Deceased November 2, 2018, this paper is dedicated to the memory of Professor Garry L. Rempel.

Table S1 Criteria for a Fractional Factorial Design [1]

Number of Factors k	Fraction	Number of Runs	Design Generators	Number of Factors k	Fraction	Number of Runs	Design Generators
3	2^{3-1}_{III}	4	$C = \pm AB$	10			$H = \pm ABCG$
4	2^{4-1}_{IV}	8	$D = \pm ABC$				$J = \pm ACDE$
5	2^{5-1}_{V}	16	$E = \pm ABCD$		2^{10-3}_{V}	128	$K = \pm ACDF$
	2^{5-2}_{III}	8	$D = \pm AB$				$G = \pm BCDF$
			$E = \pm AC$				$H = \pm ACDF$
6	2^{6-1}_{VI}	32	$F = \pm ABCDE$				$J = \pm ABDE$
	2^{6-2}_{IV}	16	$E = \pm ABC$		2^{10-4}_{IV}	64	$K = \pm ABCE$
			$F = \pm BCD$				$F = \pm ABCD$
	2^{6-3}_{III}	8	$D = \pm AB$				$G = \pm ABCE$
			$E = \pm AC$				$H = \pm ABDE$
			$F = \pm BC$				$J = \pm ACDE$
7	2^{7-1}_{VII}	64	$G = \pm ABCDEF$		2^{10-5}_{IV}	32	$K = \pm BCDE$
	2^{7-2}_{IV}	32	$E = \pm ABC$				$E = \pm ABC$
			$G = \pm ABDE$				$F = \pm BCD$
	2^{7-3}_{IV}	16	$E = \pm ABC$				$G = \pm ACD$
			$F = \pm BCD$				$H = \pm ABD$
			$G = \pm ACD$				$J = \pm ABCD$
	2^{7-4}_{III}	8	$D = \pm AB$		2^{10-6}_{III}	16	$K = \pm AB$
			$E = \pm AC$	11			$G = \pm CDE$
			$F = \pm BC$				$H = \pm ABCD$
			$G = \pm ABC$				$J = \pm ABF$
8	2^{8-2}_{V}	64	$G = \pm ABCD$				$K = \pm BDEF$
			$H = \pm ABEF$		2^{11-5}_{IV}	64	$L = \pm ADEF$
	2^{8-3}_{IV}	32	$F = \pm ABC$				$F = \pm ABC$
			$G = \pm ABD$				$G = \pm BCD$
			$H = \pm BCDE$				$H = \pm CDE$
	2^{8-4}_{IV}	16	$E = \pm BCD$				$J = \pm ACD$
			$F = \pm ACD$				$K = \pm ADE$
			$G = \pm ABC$		2^{11-6}_{IV}	32	$L = \pm BDE$
			$H = \pm ABD$				$E = \pm ABC$
9	2^{9-2}_{VI}	128	$H = \pm ACDFG$				$F = \pm BCD$
			$J = \pm BCEFG$				$G = \pm ACD$
	2^{9-3}_{IV}	64	$G = \pm ABCD$				$H = \pm ABD$
			$H = \pm ACEF$				$J = \pm ABCD$
			$J = \pm CDEF$				$K = \pm AB$
	2^{9-4}_{IV}	32	$F = \pm BCDE$		2^{11-7}_{III}	16	$L = \pm AC$
			$G = \pm ACDE$				
			$H = \pm ABDE$				
			$J = \pm ABCE$				
	2^{9-5}_{III}	16	$E = \pm ABC$				
			$F = \pm BCD$				
			$G = \pm ACD$				
			$H = \pm ABD$				
			$J = \pm ABCD$				

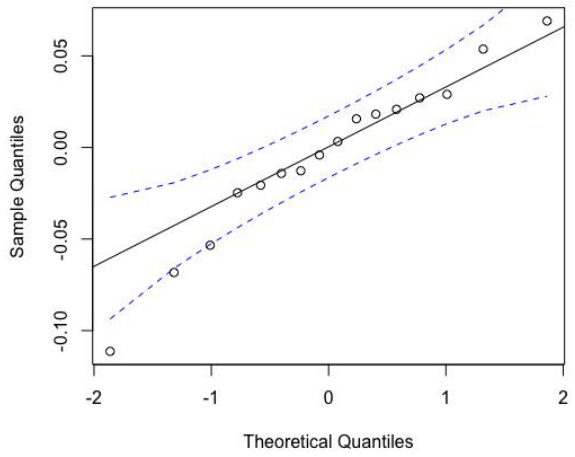

Figure S1 The normal probability plot of residual for the glycerol hydrogenolysis process with in situ hydrogen from methanol steam reforming. Catalyst: 1Pd/Cu/MgO/Al_2O_3, Cu/Mg/Al (molar) = 22.5/67.5/10. Conditions: 220 ºC, 15bar N2, 20 wt% Glycerol, Water/Methanol(molar)=1.2, 3 wt% catalyst, 500RPM.

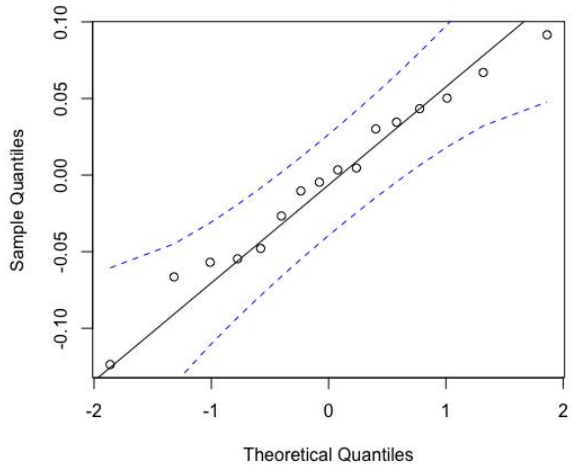

Figure S2 The normal probability plot of residual for the glycerol hydrogenolysis process with in situ hydrogen from methanol steam reforming. Catalyst: Cu/MgO/Al_2O_3, Cu/Mg/Al (molar) = 22.5/67.5/10. Conditions: 220 ºC, 15bar N2, 20 wt% Glycerol, Water/Methanol(molar)=1.2, 3 wt% catalyst, 500RPM.

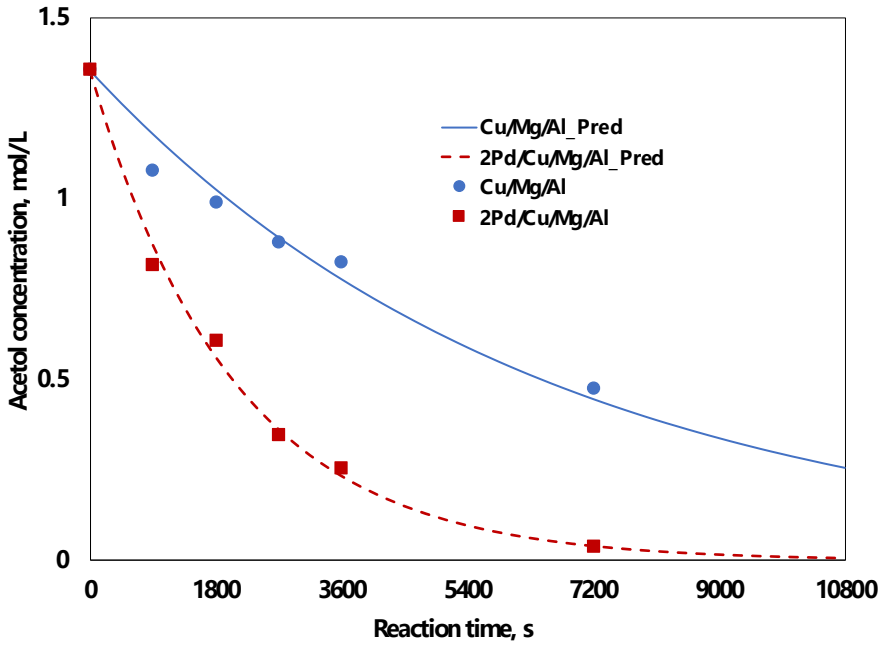

Figure S3 The concentration of different component over the reaction time for acetol hydrogenation.

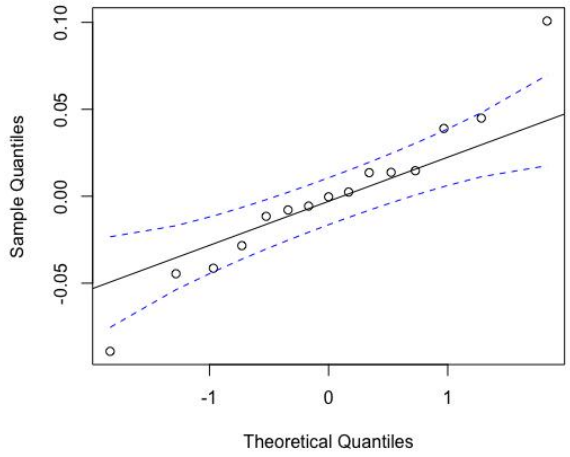

Figure S4 The normal probability plot of residual for the acetol hydrogenation. Catalyst: $Cu/MgO/Al_2O_3$.

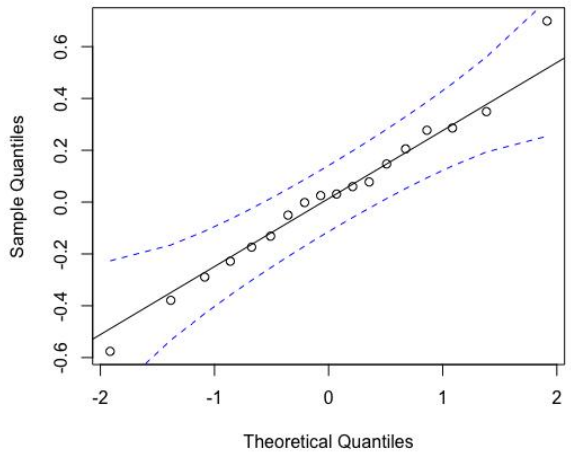

Figure S5 The normal probability plot of residual for the acetol hydrogenation. Catalyst: 2Pd/Cu/MgO/Al_2O_3.

References

[1]. Montgomery, D.C.; Runger, G.C. In *Design of experiments with several factors;* Applied statistics and probability for engineers; John Wiley & Sons, Inc.: 2002; pp 560.