

Steering the Ester and gamma-Valerolactone Selectivities in Levulinic Acid Hydrogenation

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Table S1: CO₂-TPD table

Sr.No.	Catalyst	Total CO ₂ desorbed (mmol g ⁻¹)	Temperature range-wise desorption CO ₂ (mmol g ⁻¹)		
			30-260°C	260-460°C	460-760°C
1	La ₂ O ₃	3.115	--	-	3.115
2	Co ₃ O ₄	0.131	0.112	0.012	0.007
3	Fresh Co/La ₂ O ₃	2.321	0.320	1.344	0.657
4	Used Co/La ₂ O ₃	5.444	0.598	4.639	0.208
5	Cu/La ₂ O ₃	0.871	0.048	0.708	0.114
6	Ni/La ₂ O ₃	0.924	0.267	0.656	0

Table S2: NH₃-TPD table

Sr.No.	Catalyst	Total NH ₃ desorbed (mmol g ⁻¹)	Temperature range-wise desorption NH ₃ (mmol g ⁻¹)		
			50-360°C	360-460°C	460-660°C
1	Co/La ₂ O ₃	0.5001	0.1774	0.2047	0.1180
2	Cu/La ₂ O ₃	0.2245	0.1122	0.0815	0.0308
3	Ni/La ₂ O ₃	0.1771	0.1256	0.0193	0.0322

Table S3: Results for LA esterification

Sr.No	Catalyst	Conv, %	Selectivity, %	
			GVL	MeLA
1	La ₂ O ₃	94	4.3	93
2	20% Co/La ₂ O ₃	96	9	91

Reaction conditions: Levulinic acid, 5g; solvent, MeOH 100ml; catalyst, 0.5g; temperature, 200°C; H₂ pressure, 500 psi ; reaction time, 5 h.

Figure S1: XPS spectra of Lanthanum 3d_{3/2} in 20% Co/La₂O₃, (a) Fresh and (b) Used

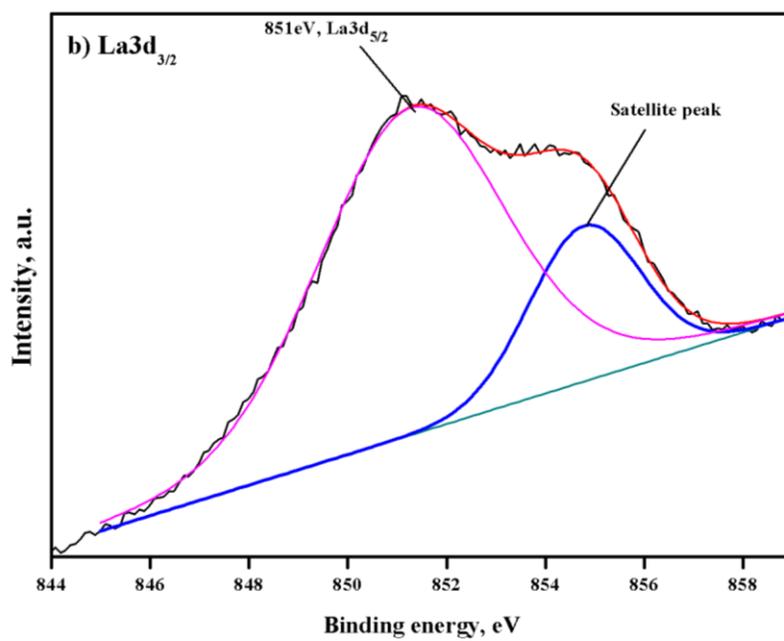
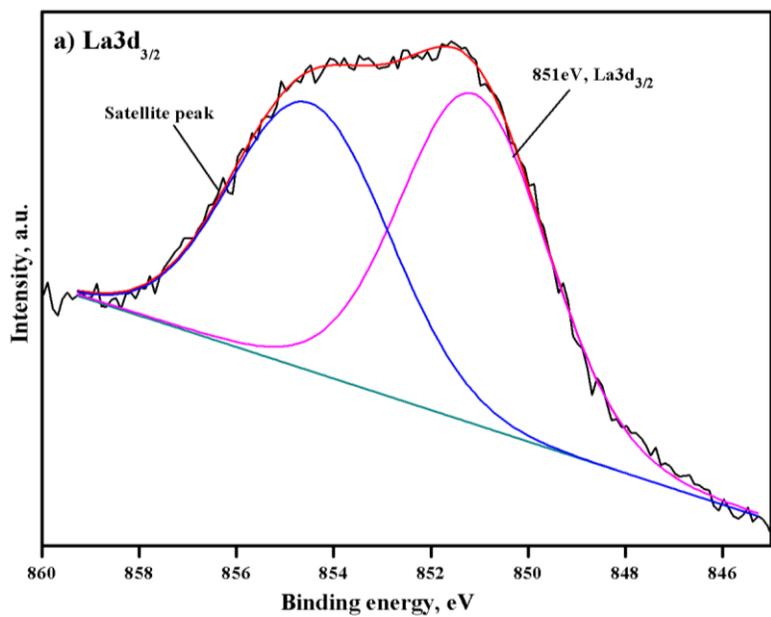


Figure S2: XPS spectra Oxygen 1s (a) Fresh, (b) Used

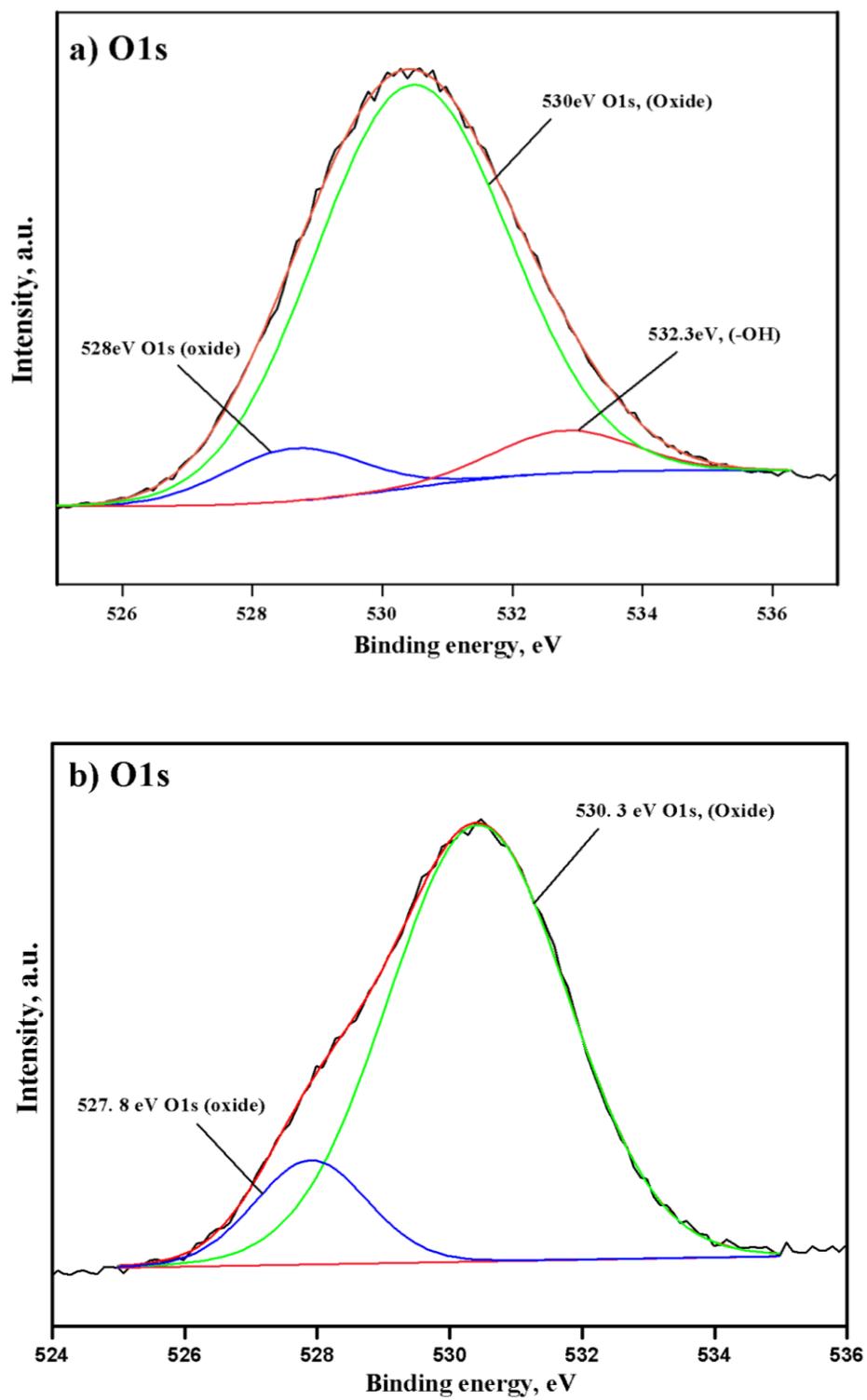


Figure S3: EDX spectrum for 20% Co/La₂O₃

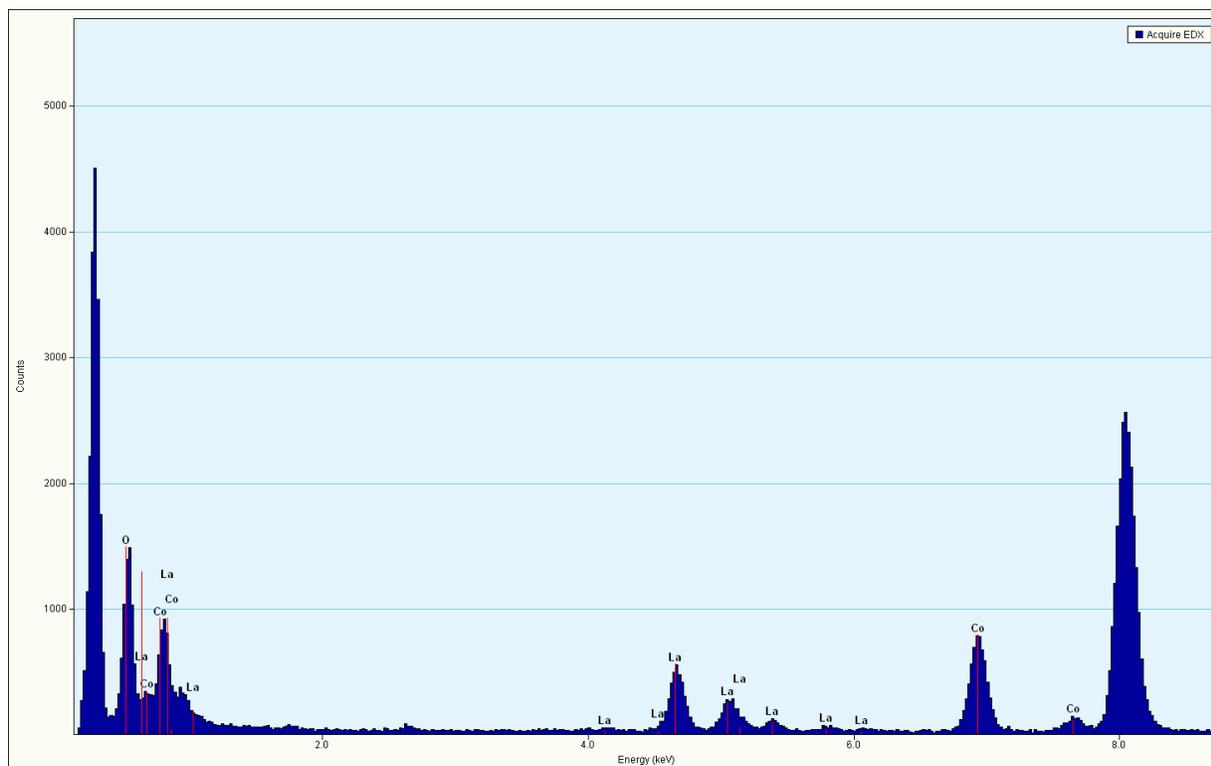


Figure S4: Ammonia TPD analysis of (a) 20% Co/La₂O₃, (b) 20% Cu/La₂O₃, (c) 20% Ni/La₂O₃

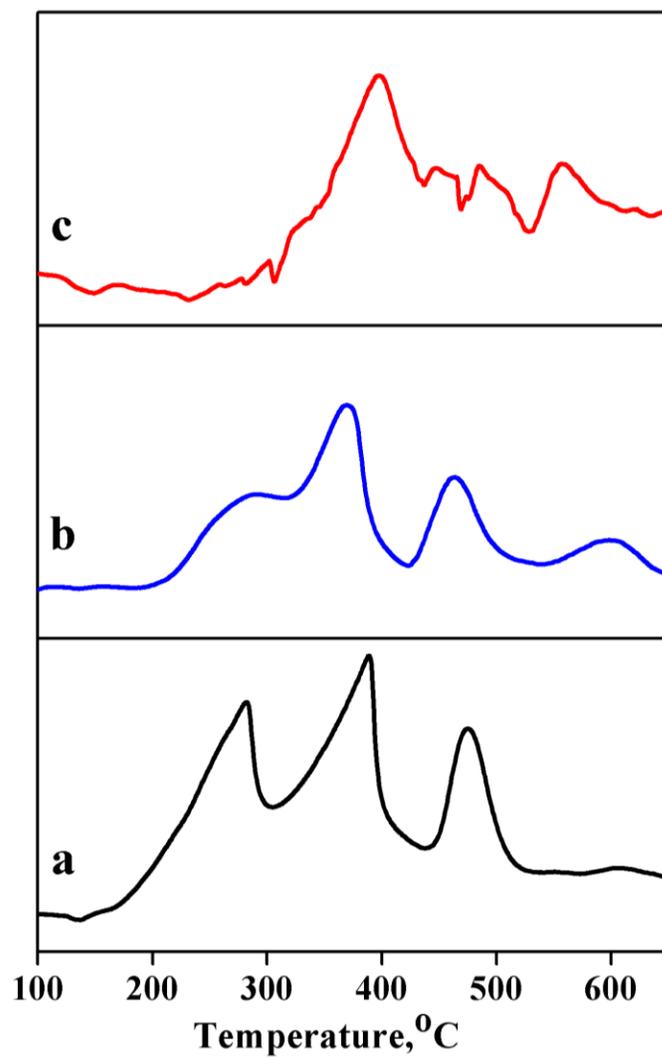


Figure S5: Py-IR spectra of catalysts

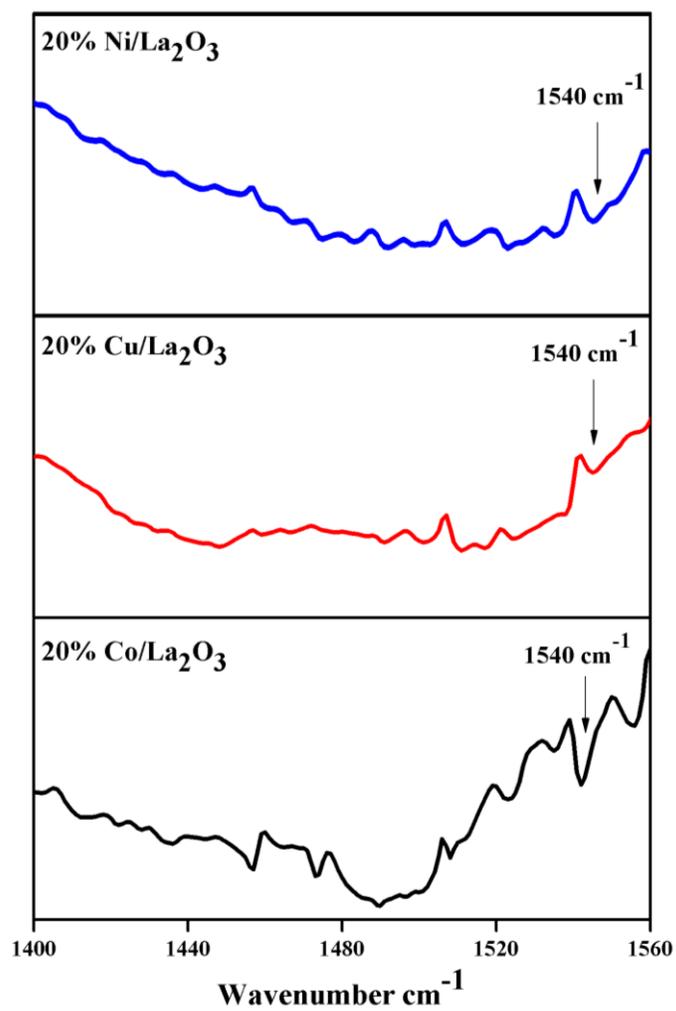
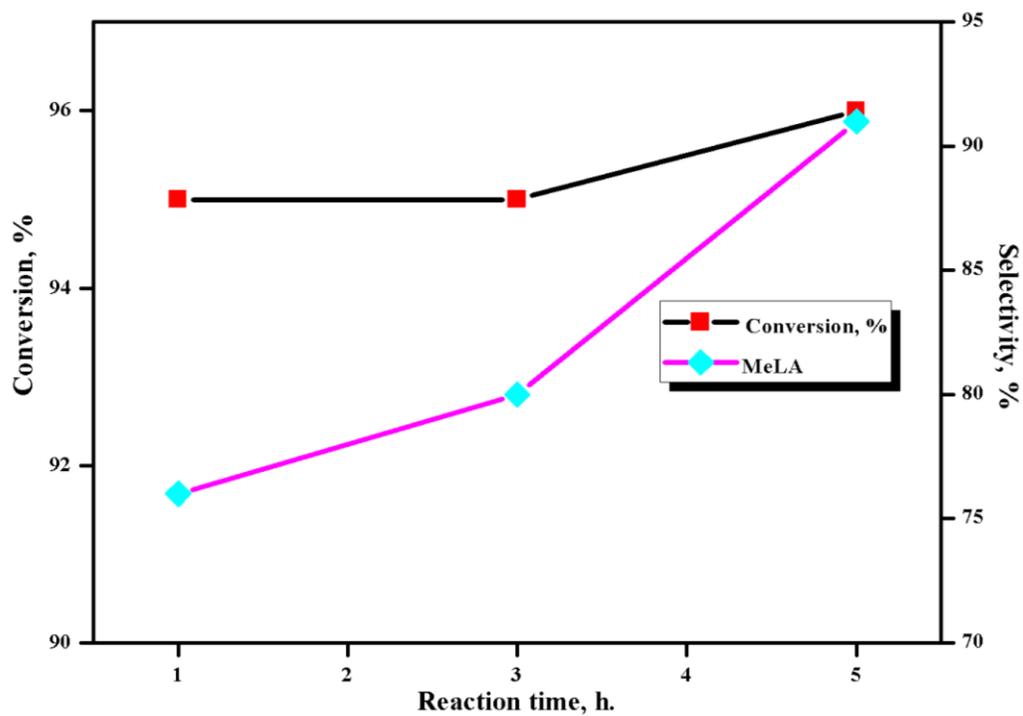
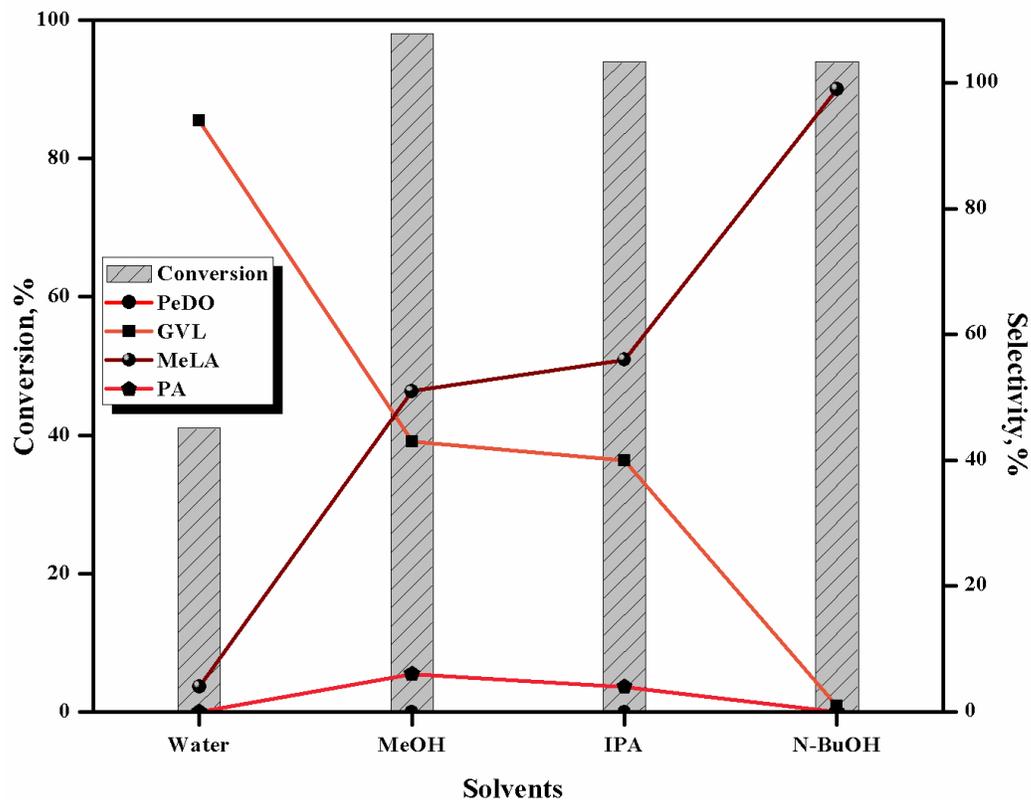


Figure S6: CT profile of Levulinic acid esterification



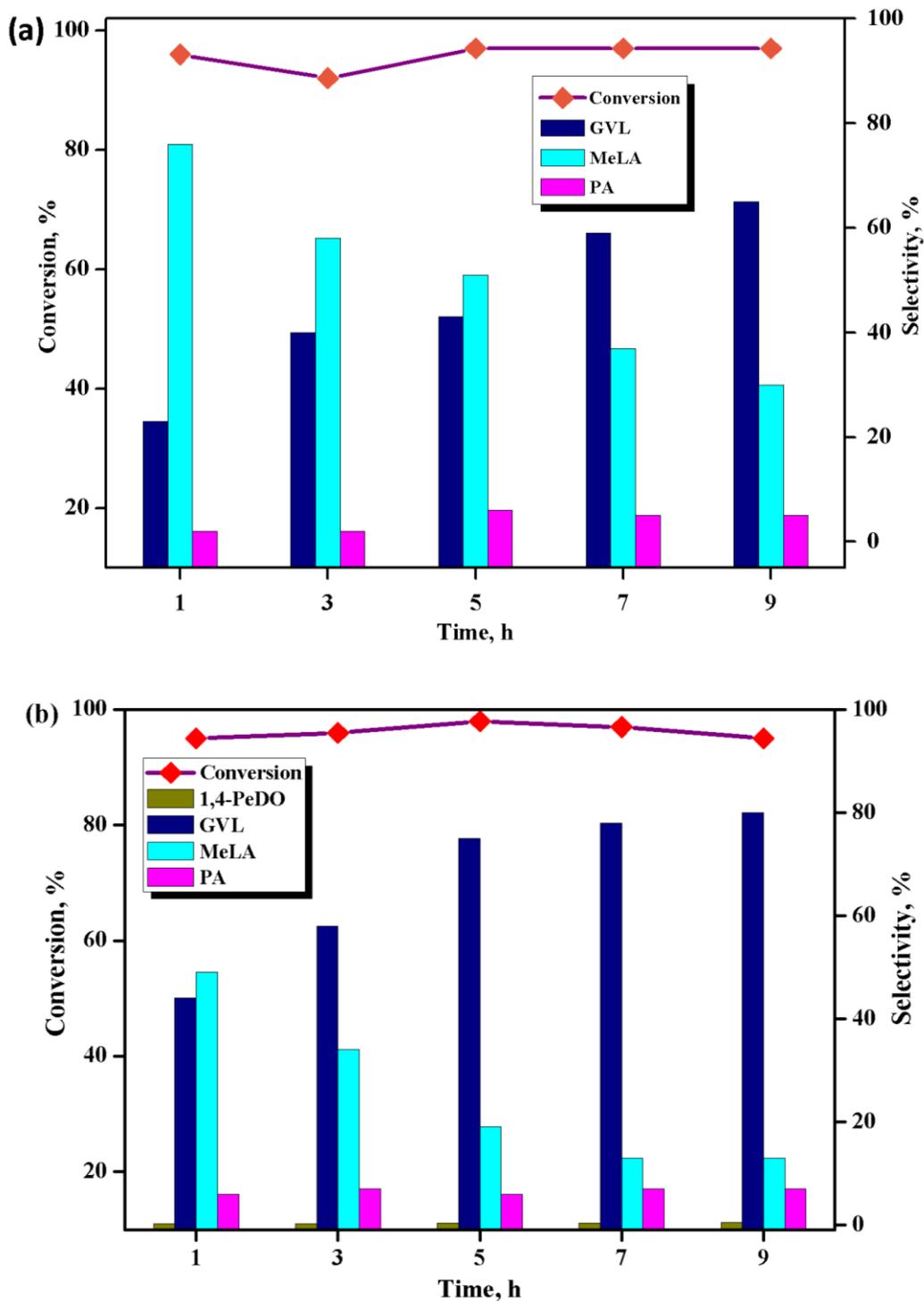
Reaction conditions: Levulinic acid, 5g; solvent, MeOH 100ml; catalyst, 0.5g; temperature, 200⁰C; reaction time, 5 h.

Figure S7: Effect of solvent on selectivity pattern



Reaction conditions: Levulinic acid, 5g; solvent, 100ml; catalyst, 0.5g; temperature, 200°C; H₂ pressure, 500 psi; reaction time, 5 h.

Figure S8: Effect of reaction time (a) without water, (b) with water



Reaction conditions: Levulinic acid, 5g; solvent, 100ml; catalyst, 0.5g; temperature, 200°C; H₂ pressure, 500 psi.

Figure S9: Catalyst magnetic properties

