Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Bimetallic Synergistic Degradation of Chlorophenols by $CuCoO_x$–LDH Catalyst in bicarbonate activated hydrogen peroxide system.

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Table S1 Activity of different LDH based metals catalyst on common MgAl support in BAP system.

Catalyst	mM of nitrate salt solution used			BET (m^2/g)	$(Co^{2+}+Mg^{2+})/Al^{3+}$	% Co load	pH	% CP removal
	Co^{2+}/other	Mg^{2+}	Al^{3+}					
CoO_x-LDH-1	0.075	15	5	92	3.015	0.60	8.68	72
CoO_x-LDH -2	0.150	15	5	94	3.030	0.78	8.65	60
CoO_x-LDH -3	0.225	15	5	94	3.045	1.11	8.66	54
CuO_x-LDH	1	15	5	84	-	-	8.53	42
MnO_x-LDH	1	15	5	61	-	-	8.58	25
FeO_x-LDH	1	15	5	57	-	-	8.49	27
ZnO_x-LDH	1	15	5	64	-	-	8.51	30
NiO_x-LDH	1	15	5	81	-	-	8.59	28
MgAl as LDH	-	15	5	82	3.0		8.72	15

Conditions: CP 100 ppm, H_2O_2 30 mM, $NaHCO_3$ 30 mM, temperature 40 ^oC, catalyst amount 1.5 g/L, reaction time 1 h.

Thermal stability of CuCoOx-LDH-2 catalyst

The DGA analysis as shown in Figure S1 indicates the weight loss on thermal heating. The first mass loss occurred at 250 °C, mainly associated with interlayer and weakly adsorbed water. From temperature 250-500°C, the mass loss is associated with CO_3^{2-}, NO_3^- and other intercalated anions chemically bonded with metals layers. The weight loss after 500 °C may be related to traces of CO_3^{2-} left after calcination.

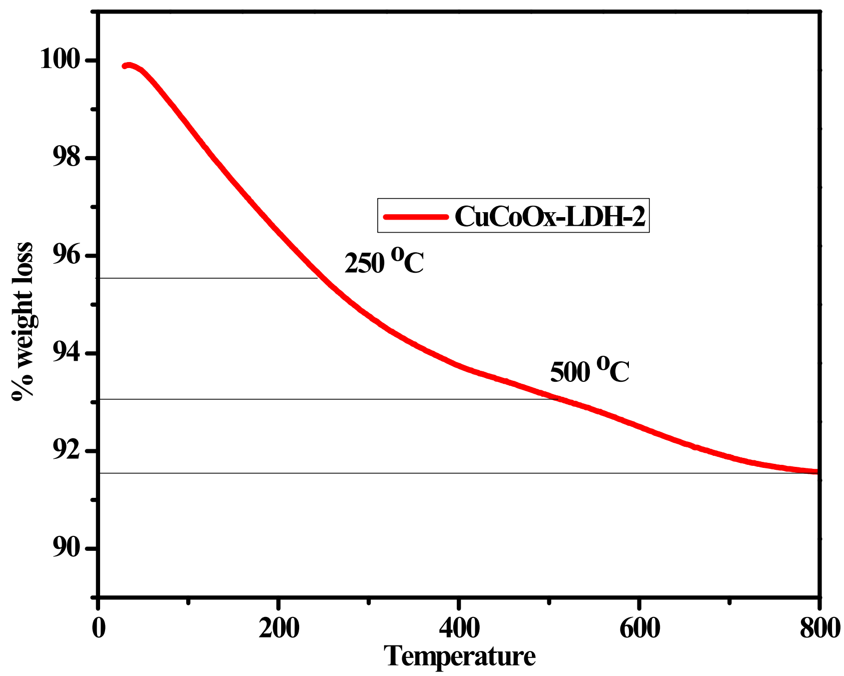

Figure S1 TGA analysis of $CuCoO_x$–LDH-2 catalyst.

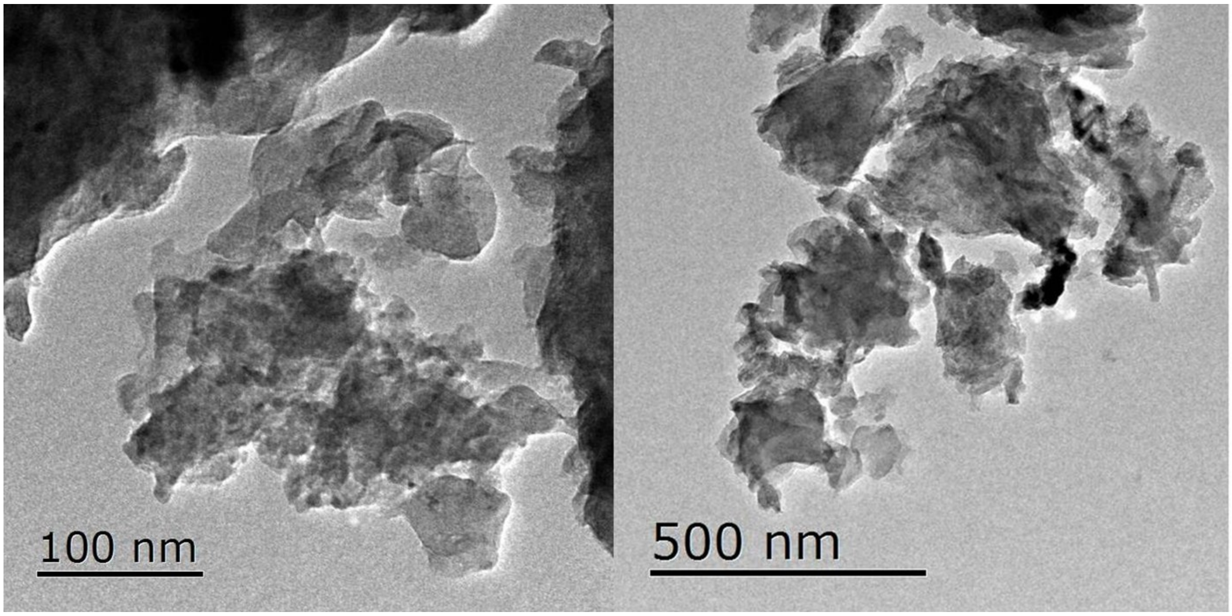

Figure S2 TEM images of $CuCoO_x$–LDH-2 catalyst.

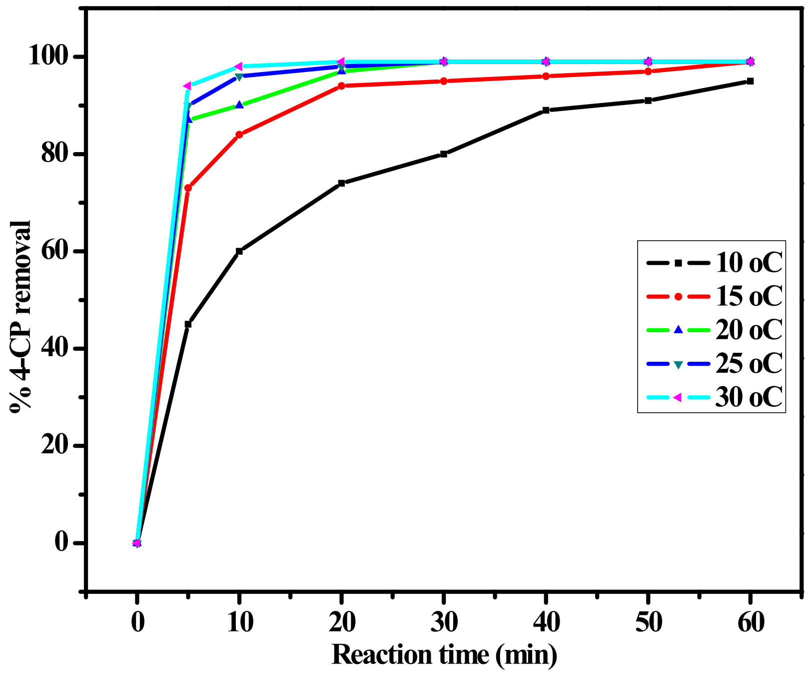

Figure S3 Effect of temperature on the catalytic activity of $CuCoO_x$–LDH-2 catalyst.

Conditions: 4-CP 100 ppm, H_2O_2 25 mM, $NaHCO_3$ 30 mM, amount of catalyst 0.5 g/L, pH 8.66, temperature 30 ^oC.

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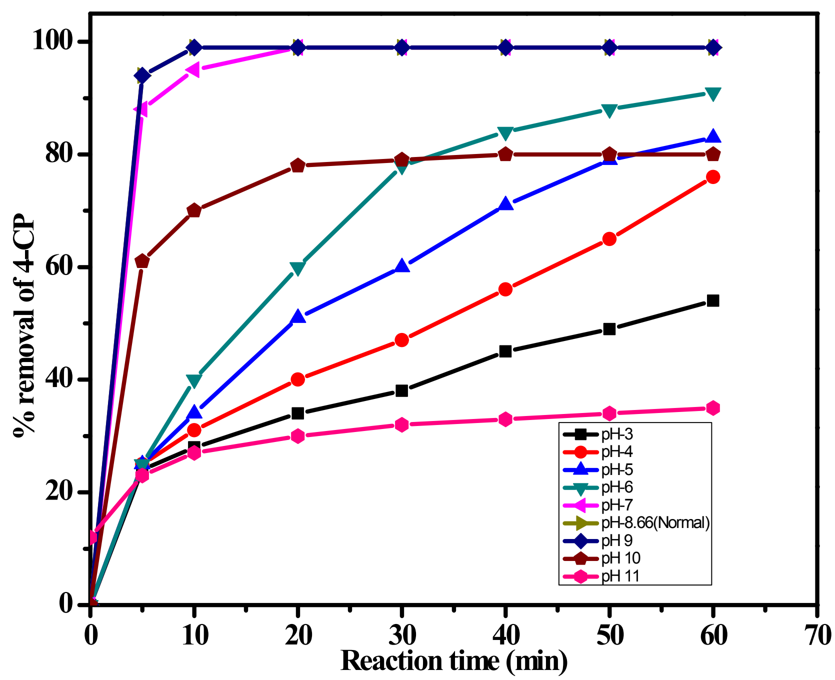

Figure S4 Effect of reaction pH on the efficiency of $CuCoO_x$–LDH-2 catalyst.

Conditions: CP 100 ppm, H_2O_2 25 mM, $NaHCO_3$ 30 mM, amount of catalyst 0.5 g/L, temperature 30 ^{o}C.

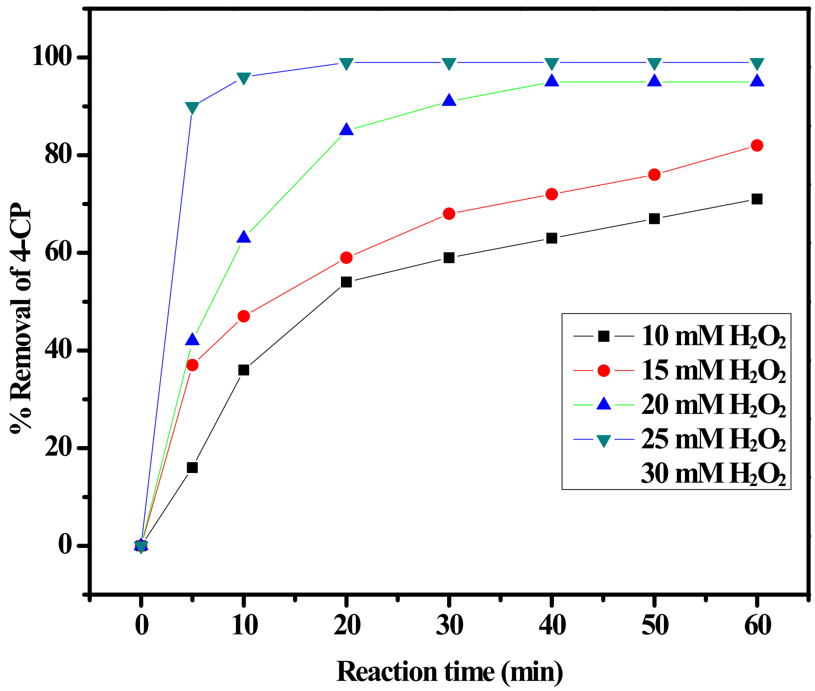

Figure S5 Influence of H_2O_2 on the efficiency of $CuCoO_x$–LDH-2 catalyst.

Conditions: CP 100 ppm, $NaHCO_3$ 30 mM, amount of catalyst 0.5 g/L, temperature 30 °C at pH 8.63 ± 0.3.

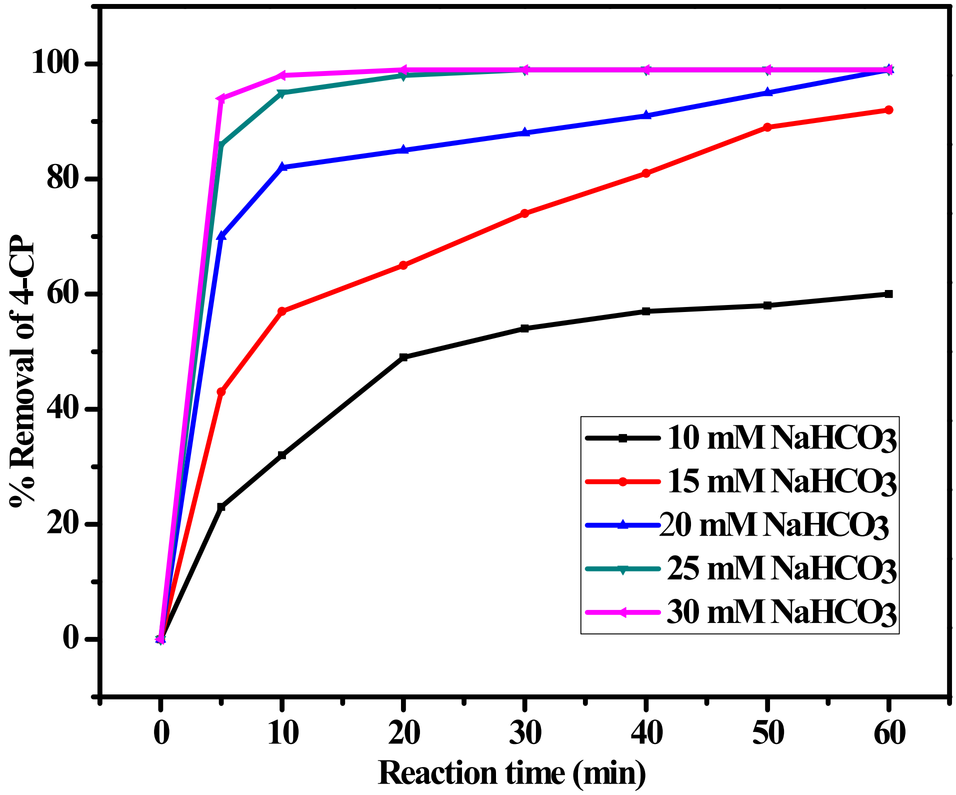

Figure S6 Effect of bicarbonate concentration on the activity of $CuCoO_x$–LDH-2 catalyst.

Conditions: CP 100 ppm, H_2O_2 25 mM, amount of catalyst 0.5 g/L, temperature 30 ^oC at pH 8.62 ±0.4.

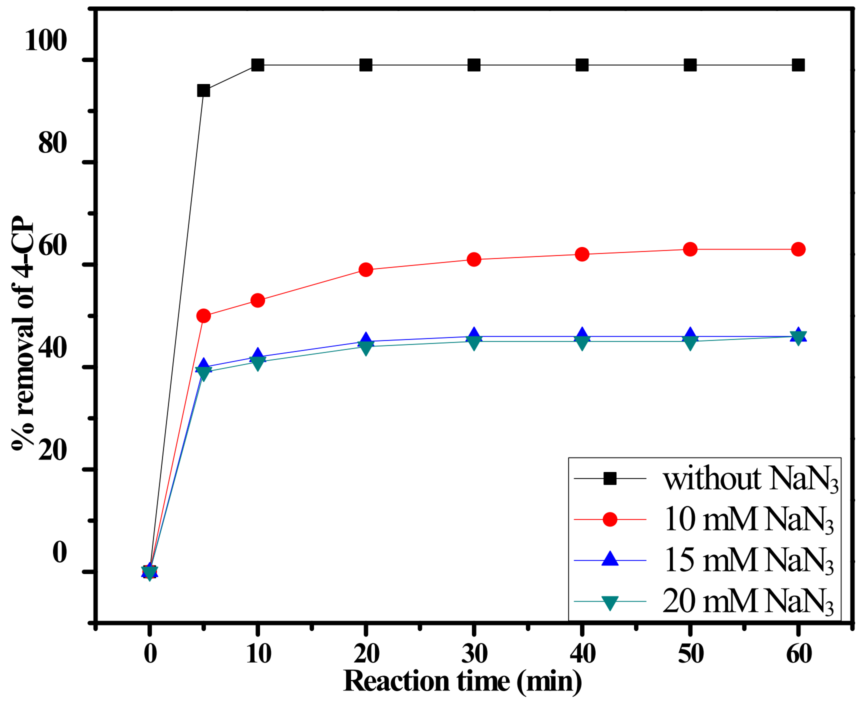

Figure S7 Scavenging role of NaN_3 during degradation of 4-CP.

Conditions: CP 200 ppm, H_2O_2 25 mM, $NaHCO_3$ 30 mM, amount of catalyst 0.5 g/L, temperature 30 ^oC.

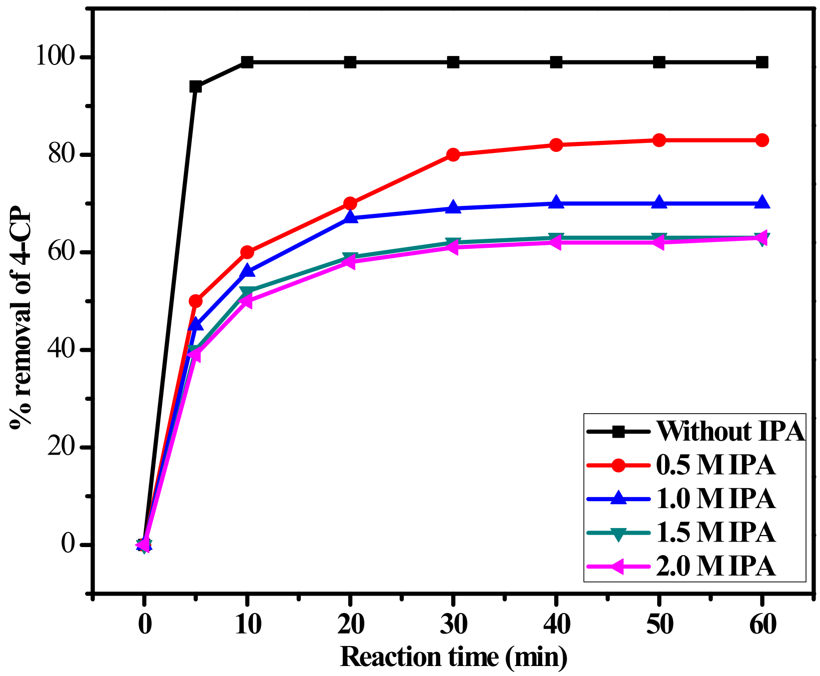

Figure S8 Scavenging action of iso propyl alcohol (IPA) during degradation of 4-CP.

Conditions: CP 200 ppm, H_2O_2 25 mM, $NaHCO_3$ 30 mM, amount of catalyst 0.5 g/L, temperature 30 ^{o}C.

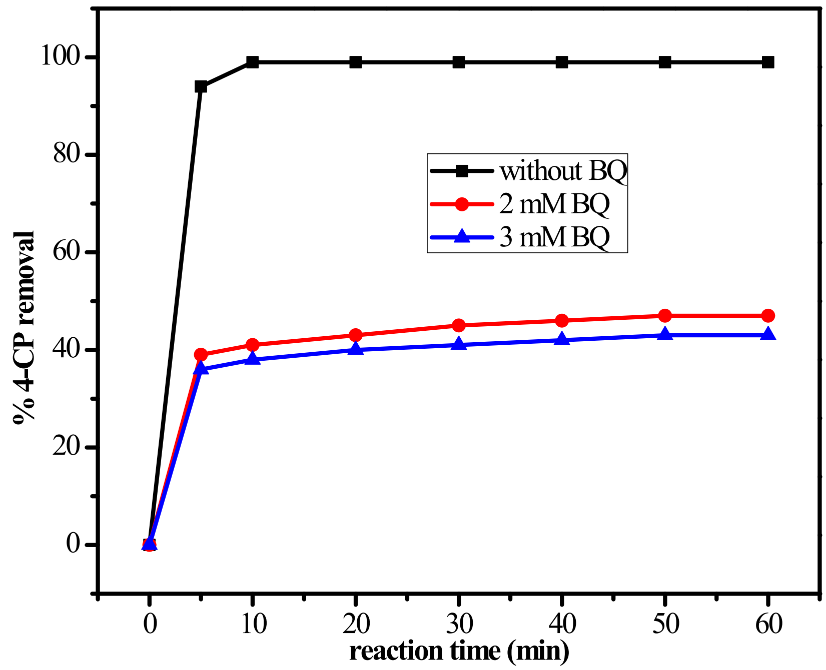

Figure S9 Influence of benzoquinone on the degradation of 4-CP.

Conditions: CP 200 ppm, H_2O_2 25 mM, $NaHCO_3$ 30 mM, amount of catalyst 0.5 g/L, temperature 30 °C.

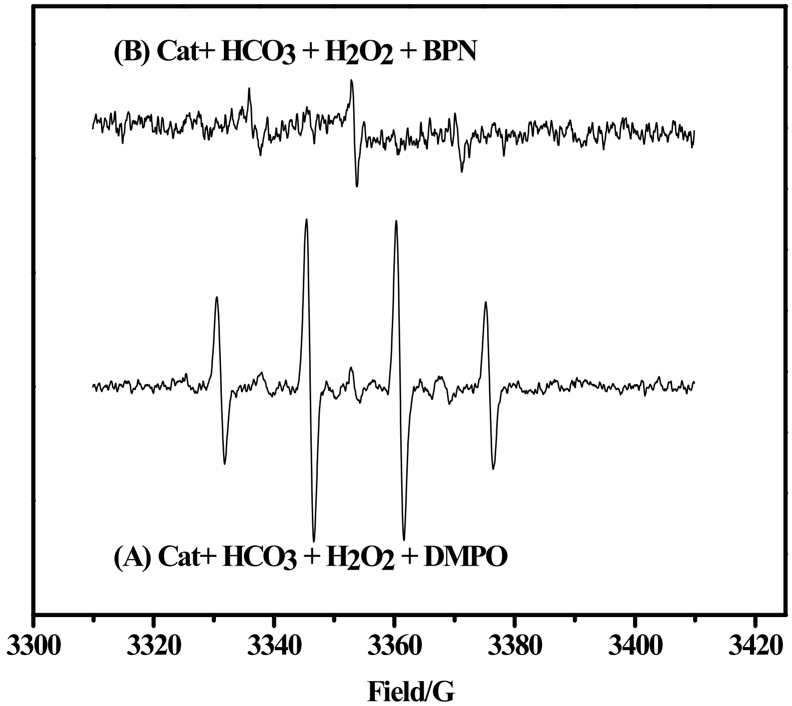

Figure S10 Generation of hydroxyl and superoxide radicals with DMPO and BPN

Conditions: DMPO 100 mM, BPN 50 mM, $NaHCO_3$ 30 mM, H_2O_2 30 mM, 10 mg/5 mL sample, 10 min reaction time, room temperature.

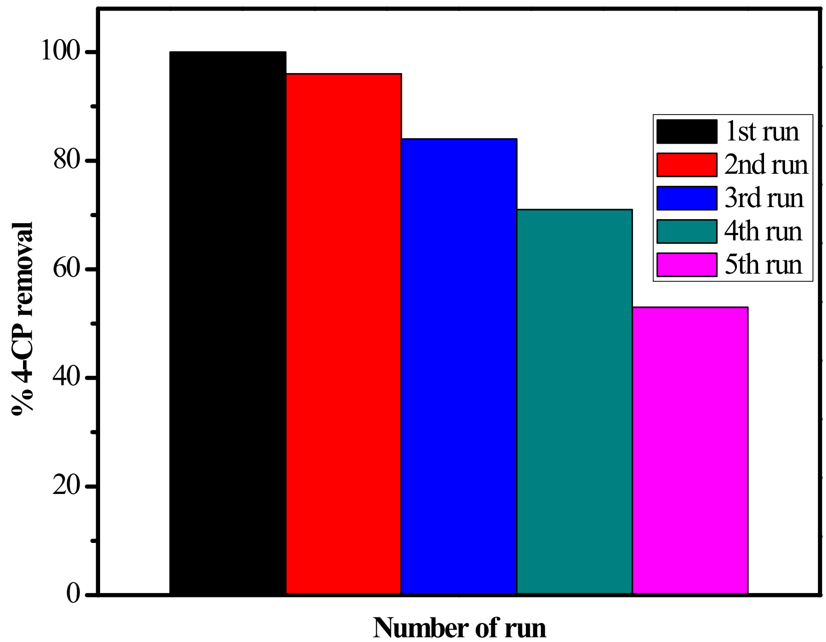

Figure S11 Stability of CuO_x@Co-LDH-2 catalyst in repeated run

Conditions: 4-CP 100 ppm, H_2O_2 25 mM, $NaHCO_3$ 30 mM, 0.5 g/L catalyst, time 1 h, temperature 30 ^oC.

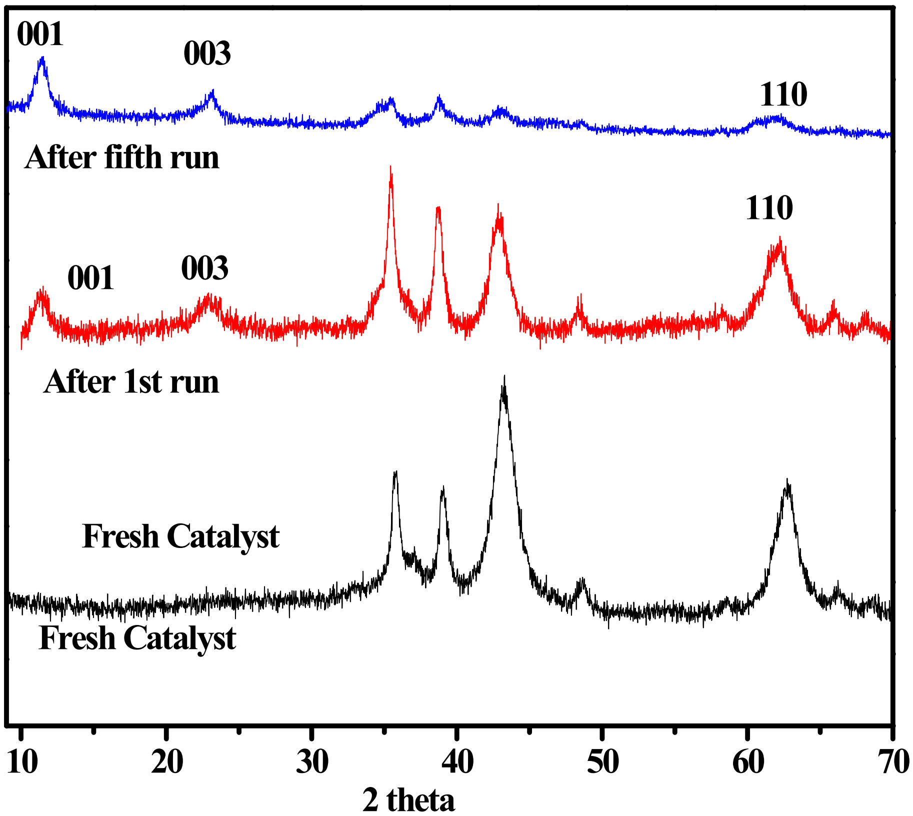

Figure S12 XRD pattern of $CuCoO_x$–LDH-2 catalyst during repeated use.