

Supporting Information

Base-Free Aerobic Oxidation of 5-Hydroxymethylfurfural on Ru(0) Center Cooperated with Co(II)/Co(III) Redox Pair over the One-Pot Synthesized Ru-Co Composites

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Table S1. Comparison of the catalytic performances of Ru-based catalysts for base-free aerobic oxidation of HMF to FDCA

Ref.	Catalyst	Conv. (%) ^a	Select. (%) ^b	Productivity (mol _{FDCA} mol _{Ru} ⁻¹ h ⁻¹)	Stability	HMF/Ru (in mol.)	T _{React.} (°C)	Time (h)	Oxidant (bar)
(1)	Ru/CTFs	99.9	78	10.3	Yes	40	140	3	air, 20
(2)	Ru/C	100	88	0.9	No	10.1	120	10	O ₂ , 2
(3)	Ru/MnCo ₂ O ₄	100	99.1	3.3	No	33.6	120	10	air, 24
(4)	Ru/HAP	100	99.9	1.0	Yes	50	120	24	O ₂ , 10
(5)	Ru/Mn ₆ Ce ₁ O _Y	100	99.9	5.3	Yes	80	150	15	O ₂ , 10
This work	Ru ₄ CoO _y (OH)	100	99.9	3.3	Yes	60	140	18	O ₂ , 10

^a Conversion of HMF. ^b Selectivity to FDCA.

Table S2. Ru loading and XPS parameters of the CoO_y(OH) and Ru_xCoO_y(OH) catalysts

Catalyst	Ru (wt%) ^a	Binding energy (eV)					FWHM (eV) ^b					$\frac{Ru^0}{Ru^0 + Ru^{4+}}$	$\frac{O_{latt.}}{O_{latt.} + O_{ads.} + O_{OH}}$
		Ru ⁰	Co ²⁺	Co ³⁺	O _{latt.}	O _{ads.}	Ru ⁰	Co ²⁺	Co ³⁺	O _{latt.}	O _{ads.}		
Ru ₁ CoO _y (OH)	0.8	462.1	781.4	780.5	529.4	531.2	3.20	3.37	1.67	1.45	1.27	45%	33%
Ru ₄ CoO _y (OH)	3.4	462.7	780.3	779.2	529.4	531.2	3.17	3.41	1.60	1.44	1.25	77%	41%
Ru ₇ CoO _y (OH)	6.1	462.4	780.6	779.5	529.6	531.1	3.16	3.42	1.70	1.43	1.24	64%	42%
Ru ₁₀ CoO _y (OH)	8.5	462.3	780.7	779.6	529.7	531.1	3.19	3.39	1.66	1.44	1.26	52%	42%

^aMeasured by ICP-MS. ^b Full width at half maxima was obtained by peak fitting.

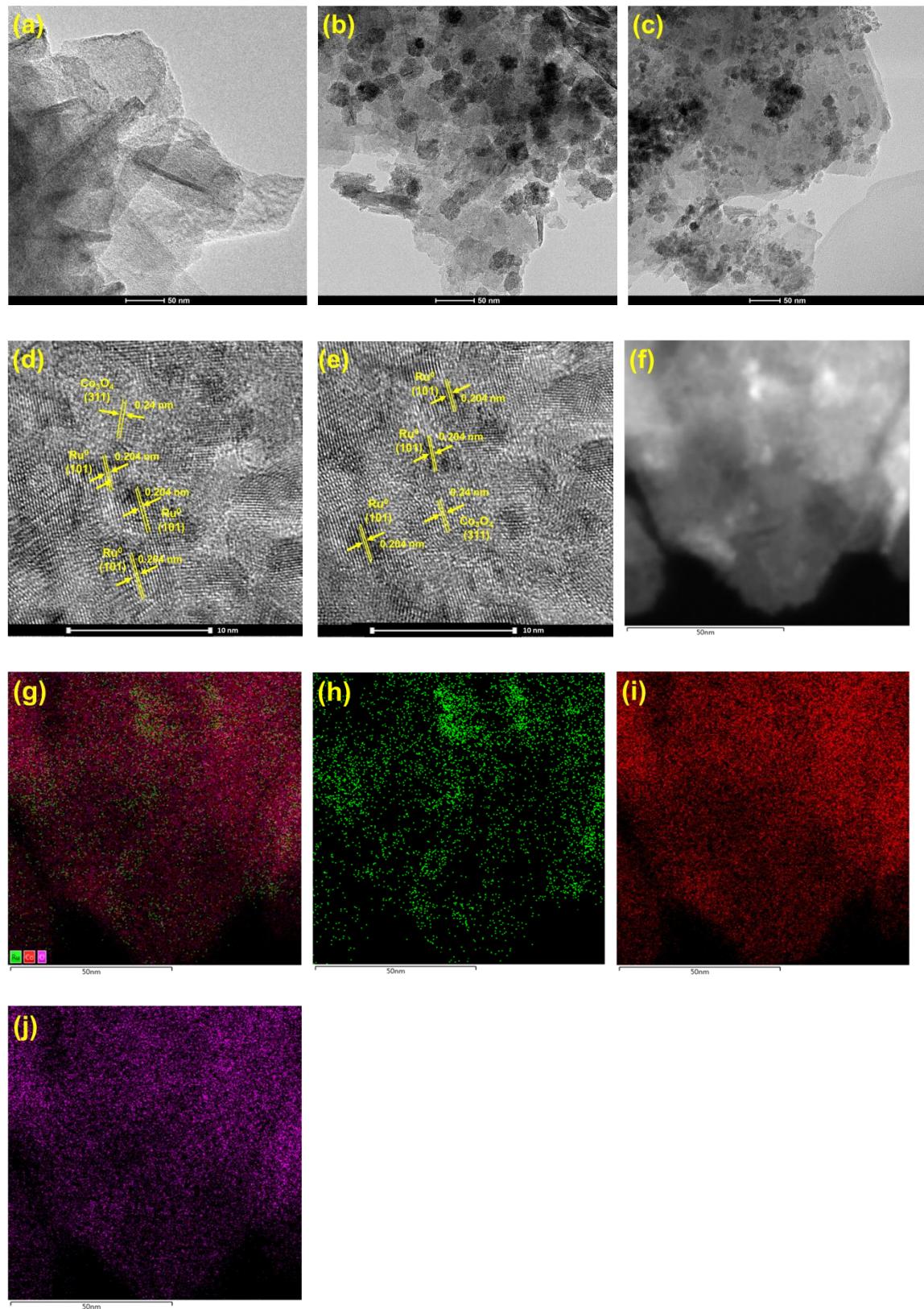


Figure S1. (HR)TEM images of the (a) $\text{Ru}_1\text{CoO}_y(\text{OH})$, (b, d) $\text{Ru}_4\text{CoO}_y(\text{OH})$, and (c, e) $\text{Ru}_7\text{CoO}_y(\text{OH})$ catalysts. (f-j) Color-coded EDS elemental maps of Ru (green), Co (red) and O (purple) for the $\text{Ru}_4\text{CoO}_y(\text{OH})$ catalyst.

References

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