Supporting Information

Catalytic oxidation of benzene over ruthenium-cobalt bimetallic catalysts and the mechanism study

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Table S1. The characterizations and evaluations data for various samples

Catalyst	Ru content (wt.%)[a]	S_{BET} (m^2/g)	T_{50} (^oC)	T_{90} (^oC)
Ru/TiO_2	1 (1.01)	52.34	221	229
$Ru\text{-}1Co/TiO_2$	1 (1.02)	51.91	212	220
$Ru\text{-}3Co/TiO_2$	1 (1.04)	51.62	219	227
$Ru\text{-}5Co/TiO_2$	1 (1.01)	51.23	204	215
$Ru\text{-}10Co/TiO_2$	1(1.03)	50.01	217	225
$5Co\text{-}Ru/TiO_2$	1 (1.00)	51.07	219	227
$(Ru\text{-}5Co)/TiO_2$	1 (0.97)	51.32	218	227

[a] The data in parenthesis show the values measured by ICP-OES.

Table S2. The XPS data for the bimetallic Ru-Co catalysts.

Catalyst	Ru_{cus} (At. %)	$Ru_{cus}+O_{ot}$ (At. %)	Ru^{4+} (At. %)	Co (At. %)	Ru/Co	O_{ads}/O_{latt}
Ru-1Co/TiO_2	0.211	0.103	0.122	0.663	0.778	0.083
Ru-3Co/TiO_2	0.216	0.099	0.131	0.926	0.482	0.065
Ru-5Co/TiO_2	0.243	0.141	0.125	0.639	0.796	0.116
Ru-10Co/TiO_2	0.171	0.095	0.101	1.009	0.364	0.073
5Co-Ru/TiO_2	0.197	0.068	0.112	1.078	0.349	0.071
(Ru-5Co)/TiO_2	0.178	0.11	0.096	1.095	0.351	0.071

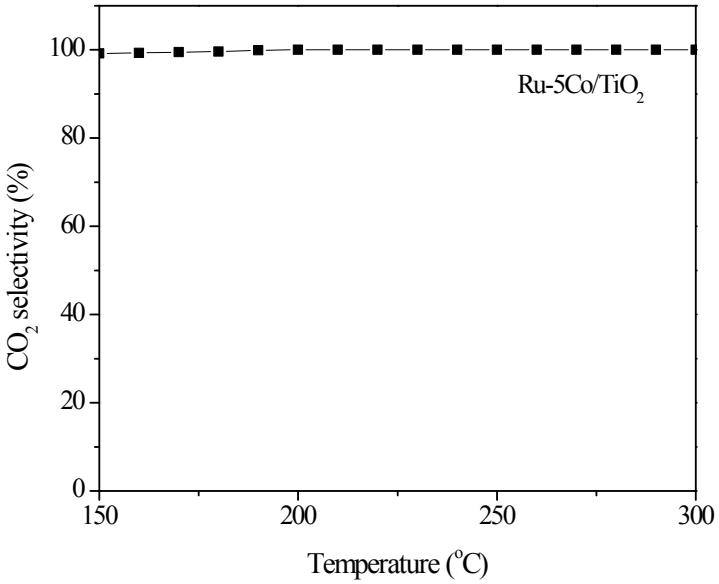

Fig. S1. CO_2 selectivity of benzene oxidation over Ru-5Co/TiO_2.

In the catalytic oxidation of benzene over Ru-5Co/TiO_2, organic byproducts were not observed by GC. Hence, the CO_2 selectivity was calculated using the equation: CO_2 selectivity = [C(CO_2)/(C(CO_2) + C(CO))]. The CO_2 selectivity was above 99% within the temperature range of 150-300 °C due to the high oxidation efficiency of Ru-5Co/TiO_2.

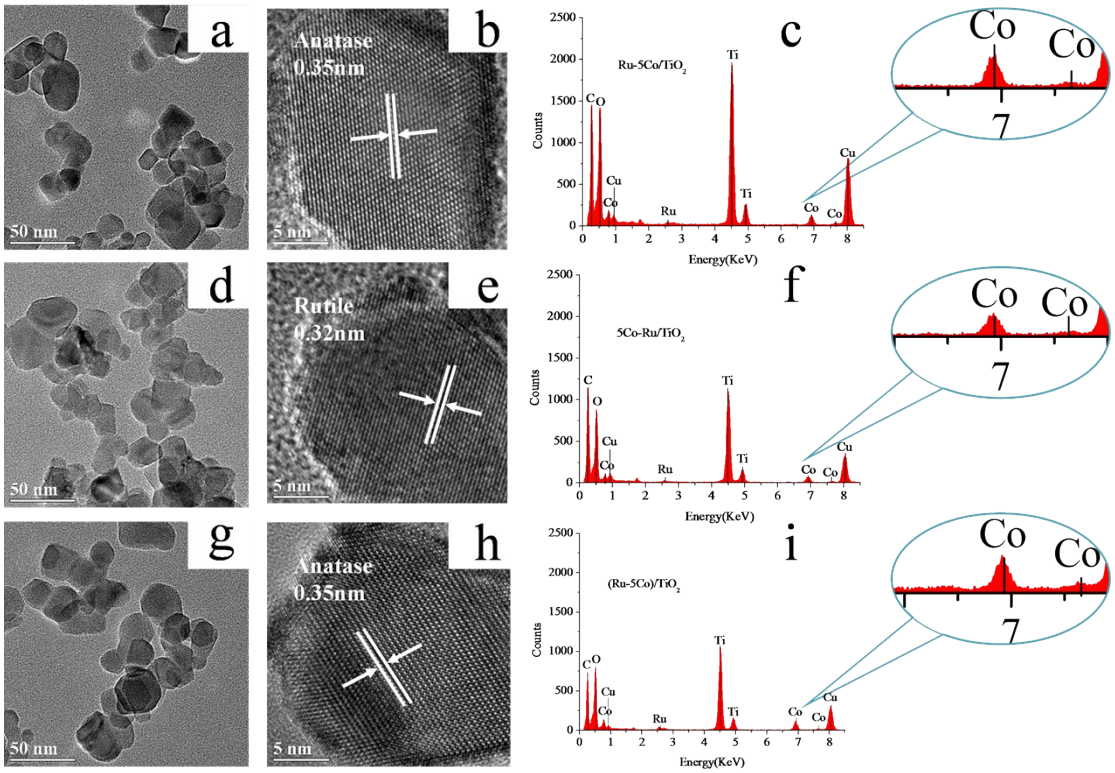

Fig. S2. TEM, HR-TEM, and EDX images for (a-c) Ru-5Co/TiO_2, (d-f) 5Co-Ru/TiO_2, and (Ru-5Co)/TiO_2, respectively

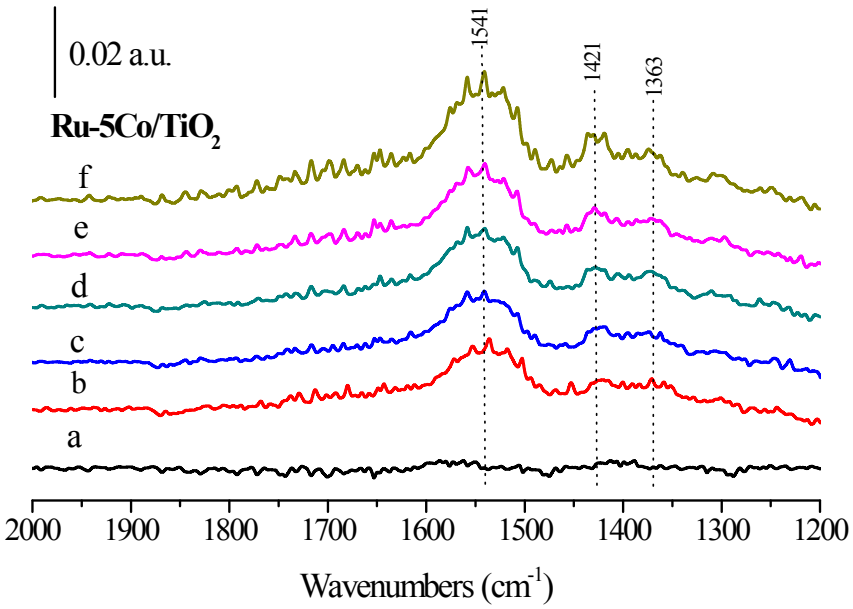

Fig. S3. *In-situ FTIR* spectra for Ru-5Co/TiO_2 collected at 240 °C after (a) 1, (b) 3, (c) 10, (d) 20, (e) 30, (f) 60 min on 500 ppm benzene/Ar stream.