

Supplementary Information

Ceria-Supported Ruthenium Catalysts for the Synthesis of Indole via Dehydrogenative

***N*-Heterocyclization**

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1. Nitrogen gas adsorption analysis of the catalyst

BET surface areas of representative supported catalysts used in the present study are summarized in Table S1. The Ru/CeO₂(KOH)-400 catalyst showed typical type IV nitrogen adsorption/desorption isotherms, which indicate that their pore sizes were within the mesopore region. The catalysts supported on CeO₂-ZrO₂ mixed oxides had slightly smaller BET surface areas than those supported on pure ceria and zirconia.

Table S1. BET surface areas of the catalysts

Entry	Catalyst	BET surface area (m ² /g)	Entry	Catalyst	BET surface area (m ² /g)
1	Ru/CeO ₂ (KOH)-400	102	6	Ru/SiO ₂ -400	269
2	Ru/CeO ₂ (KOH)-200	112	7	Ru/Al ₂ O ₃ -400	142
3	Ru/ZrO ₂ -400	95	8	Ru/CeO ₂ -ZrO ₂ (80/20)	66
4	Ru/MgO-400	148	9	Ru/CeO ₂ -ZrO ₂ (50/50)	55
5	Ru/TiO ₂ -400	49	10	Ru/CeO ₂ -ZrO ₂ (20/80)	82

2. XRD patterns of the supported-Ru catalysts calcined at 400 °C

XRD patterns of Ru catalysts supported on various oxides are shown in Figure S1. The calcination temperature was 400 °C. Peaks due to crystalline RuO₂ were observed for Ru catalysts supported on SiO₂ and Al₂O₃. On the other hand, such peaks were not observed for catalysts supported on CeO₂, ZrO₂, TiO₂, and MgO, which implied the formation of dispersed Ru species on the surface. The XRD patterns of CeO₂-ZrO₂ mixed oxides are shown in Figure S2. Diffraction peaks due to the mixed oxides shifted toward lower angles with an increase in the Ce/Zr ratio, indicating the formation of solid solutions of ceria and zirconia.

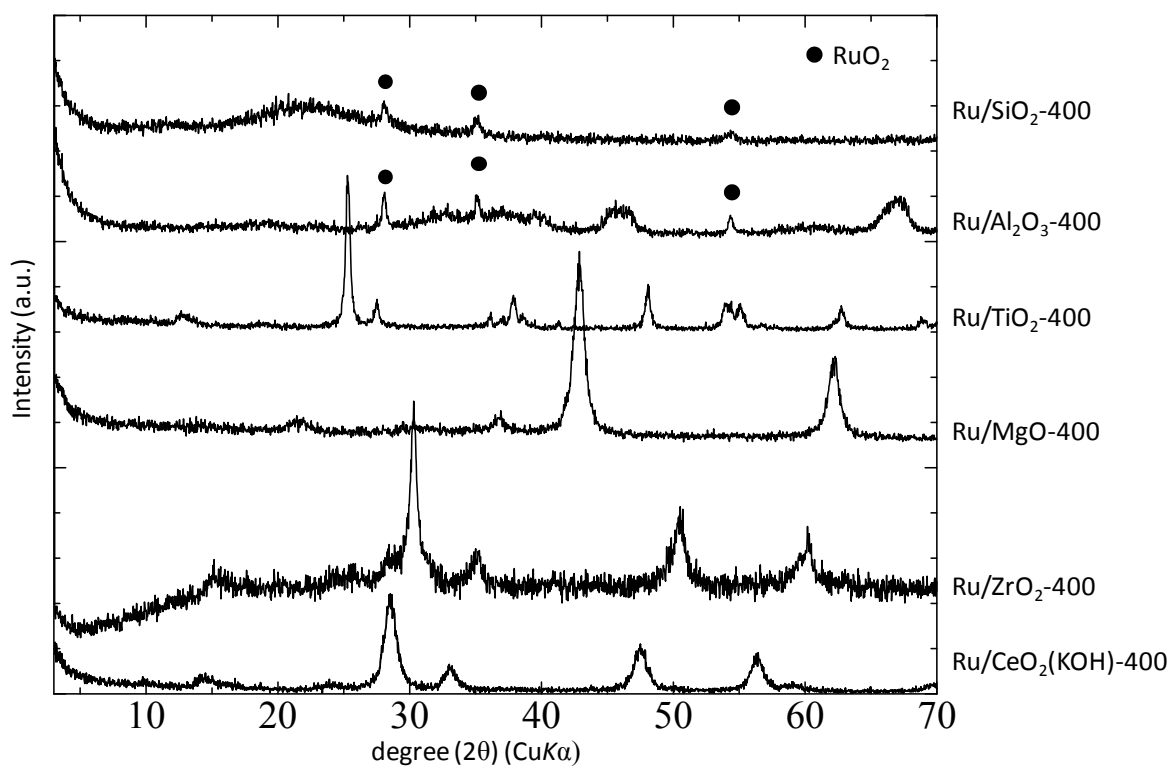


Figure S1. XRD patterns of the supported-Ru catalysts calcined at 400 °C.

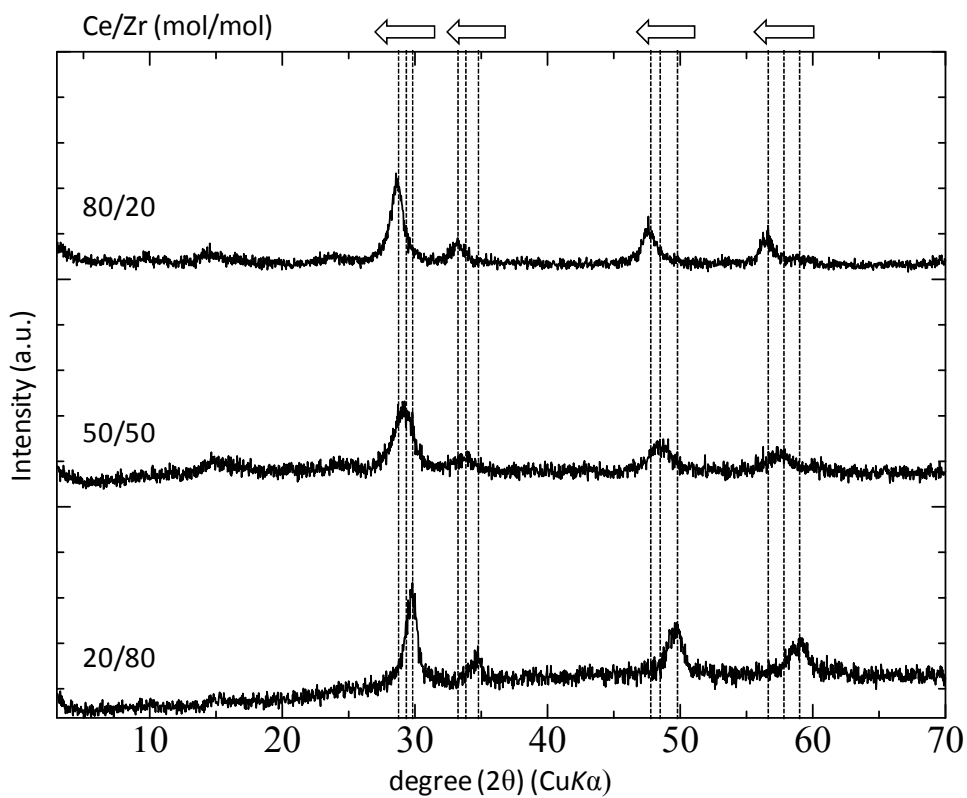


Figure S2. XRD patterns of ceria-zirconia mixed oxides

3. TG-DTA profiles of as-impregnated Ru/CeO₂

Figure S3 shows TG-DTA profiles of as-impregnated Ru/CeO₂(KOH) in air. There was an exothermic weight decrease at around 200 °C, and the extent of this decrease is almost consistent with the weight of acetylacetonato ligands in the catalyst (5.6%).

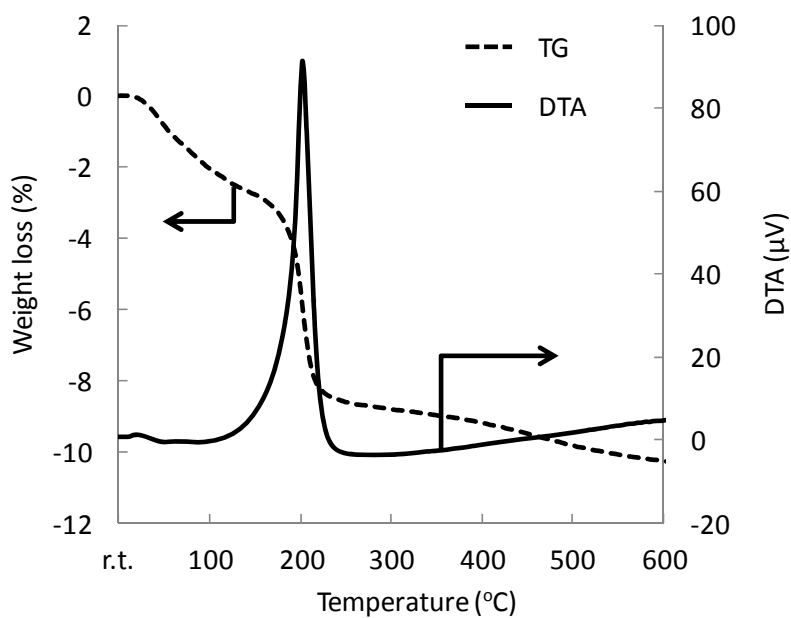


Figure S3. TG-DTA profile of Ru/CeO₂(KOH)-as-imp.