Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Supporting Information

Lean NO_x Reduction by CO at Low Temperature over Bimetallic $IrRu/Al_2O_3$ Catalysts with Different Ir:Ru Ratios

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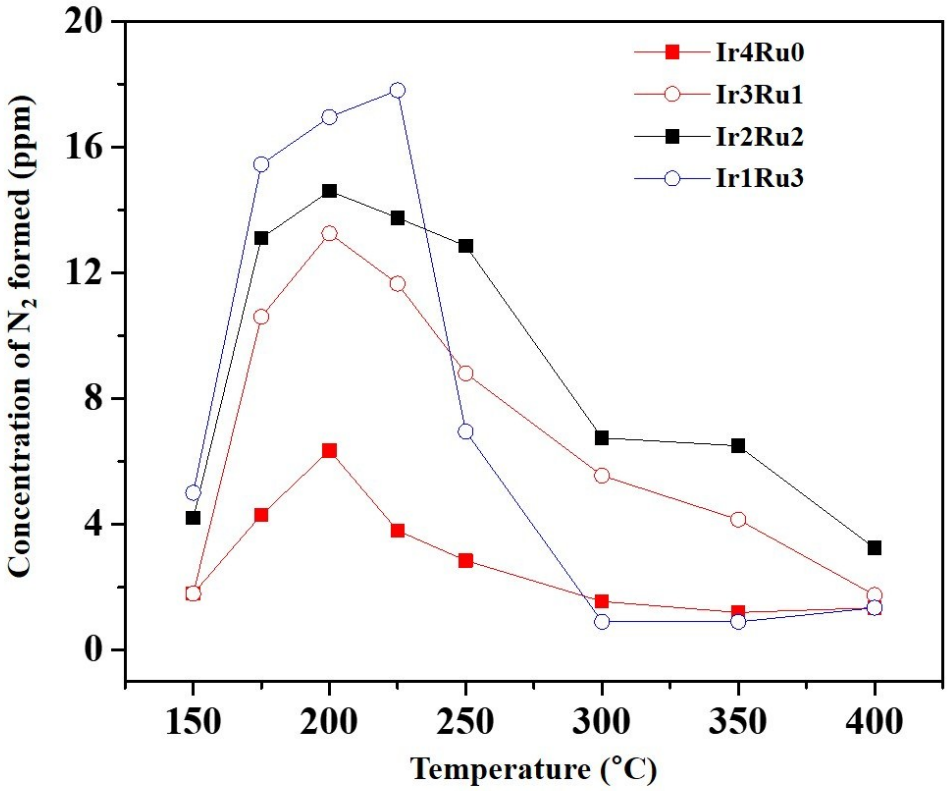

Fig. S1. Concentrations of N_2 formation over IrRu catalysts, calculated indirectly from NO_x conversion and N_2O concentration data in Figure 1. Ir0Ru4 sample is excluded from calculation due to its inert activity in NO_x reduction. It was assumed that only N_2 and N_2O is formed as a result of NO_x reduction, as NH_3 formation was not detected.

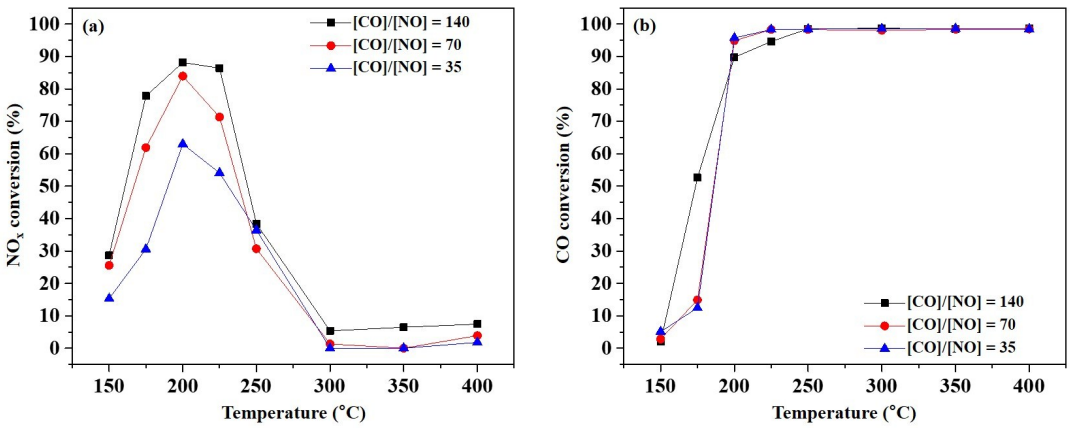

Fig. S2. The effect of CO/NO ratio within the inlet feed on the (a) NO_x conversion, and (b) CO conversion of Ir1Ru3 catalyst. CO concentration within the inlet feed was fixed to 7000 ppm, whereas the NO concentration was varied from 50 ppm ([CO]/[NO] = 140), to 100 ppm ([CO]/[NO] = 70) and 200 ppm ([CO]/[NO] = 35). Other reaction and pretreatment conditions were maintained constant as described in the experimental section.

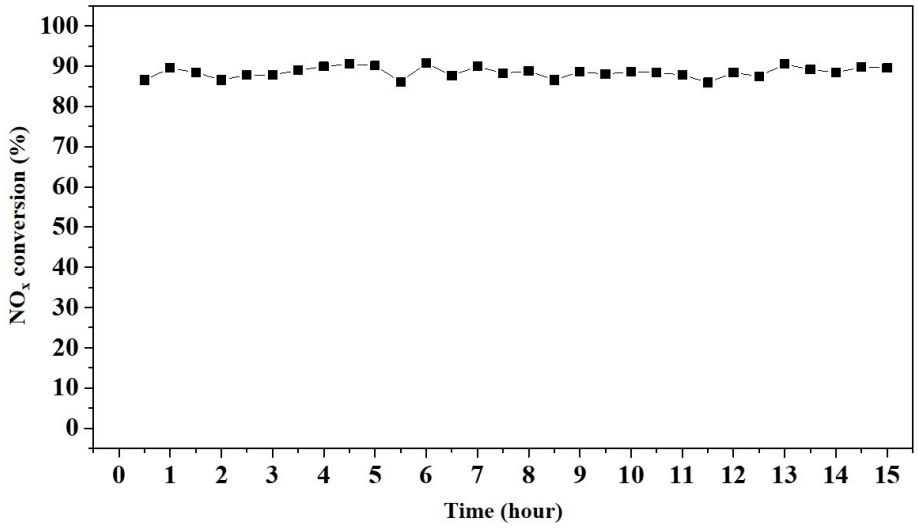

Fig. S3. Long-run tests over Ir1Ru3 catalyst at 200 °C, taken for 900 minutes (15 hours). Reaction and pretreatment conditions were maintained constant as described in the experimental section (Inlet gas composition: 50 ppm of NO, 7000 ppm of CO, 5 % of O_2 balanced with N_2).

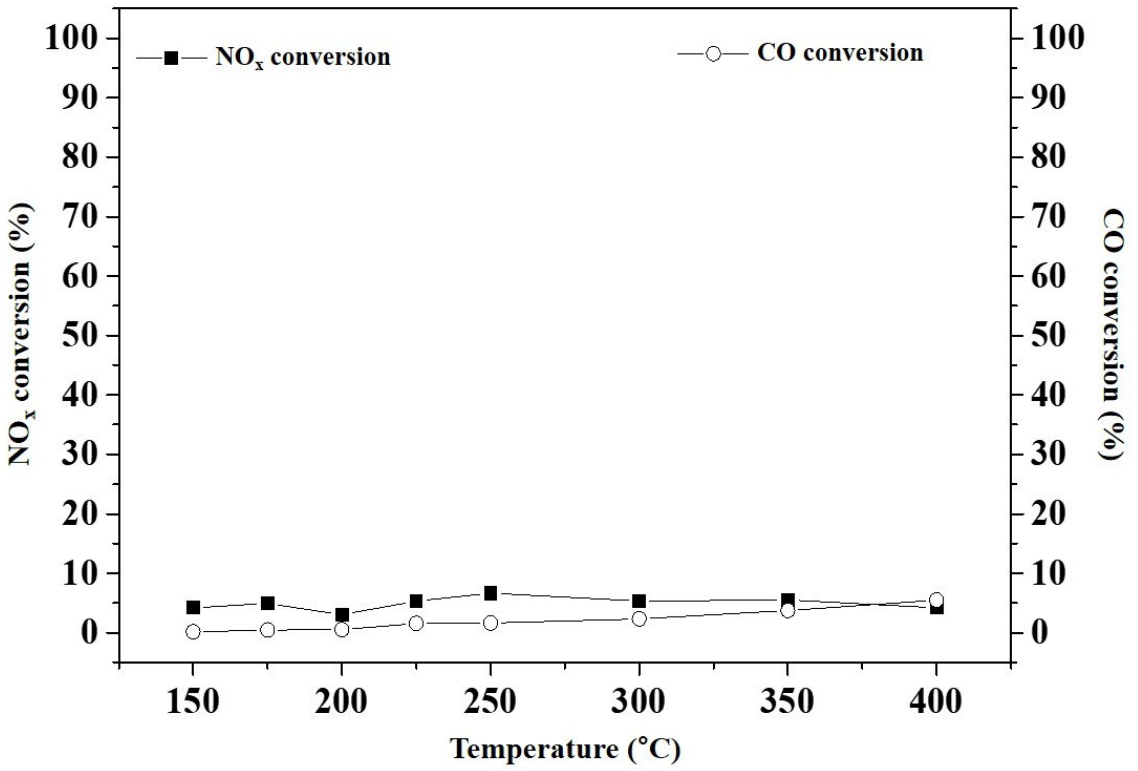

Fig. S4. Catalytic activity of the gamma-alumina support, without any impregnated iridium or ruthenium species. Reaction and pretreatment conditions were maintained constant as described in the experimental section (Inlet gas composition: 50 ppm of NO, 7000 ppm of CO, 5 % of O_2 balanced with N_2).

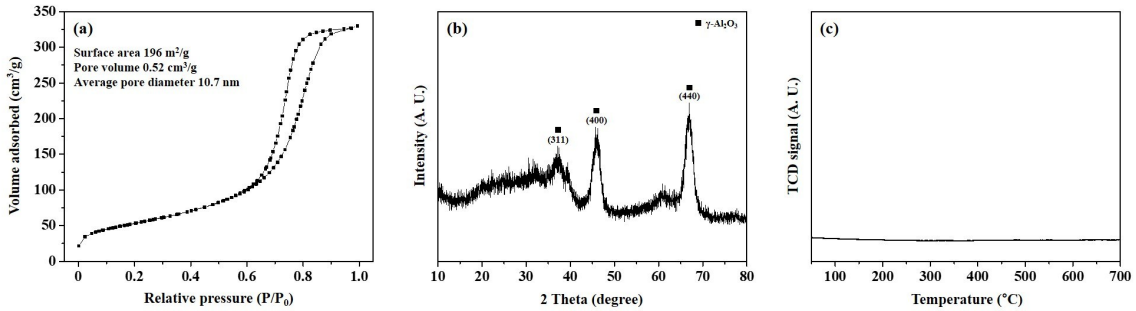

Fig. S5. (a) Nitrogen adsorption-desorption isotherm, (b) XRD analyses, and (c) TPR profile of the gamma-alumina support. Surface area, pore volume, and average pore diameter calculated from BET methods are also displayed within Figure S5(a). The scale of y-axis in Figure S5(b) and (c) are normalized with regard to those shown in Figure 2 and 3, respectively.

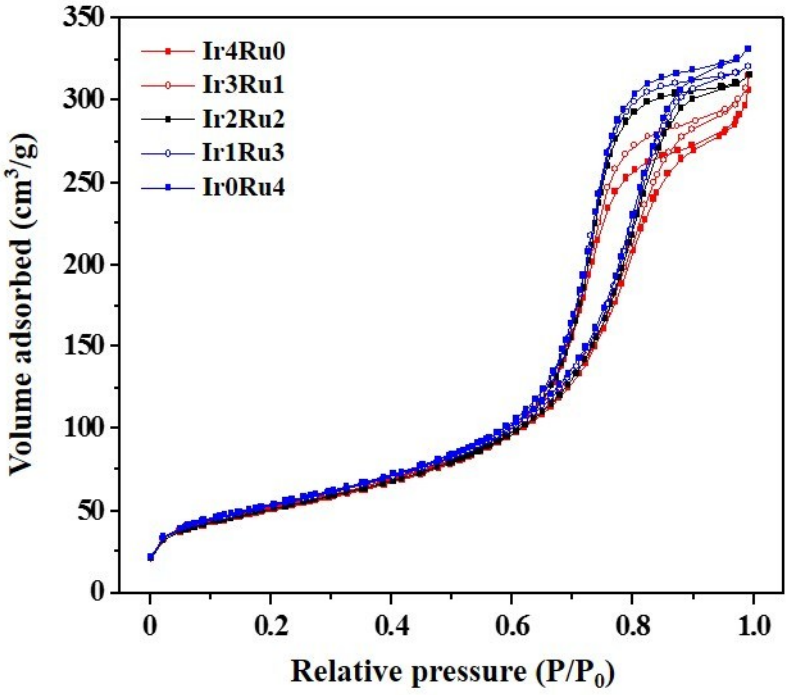

Fig. S6. Nitrogen adsorption-desorption isotherms of calcined IrRu catalysts

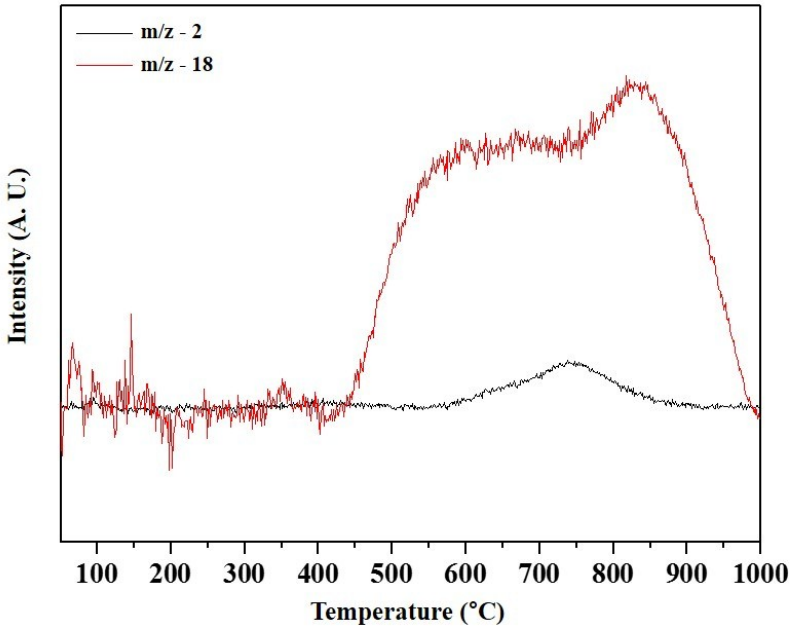

Fig. S7. MSD signals corresponding to H_2 (m/z value of 2) and H_2O (m/z value of 18) collected during H_2-TPD analyses over SBA200 alumina support. The y-axis are not normalized.

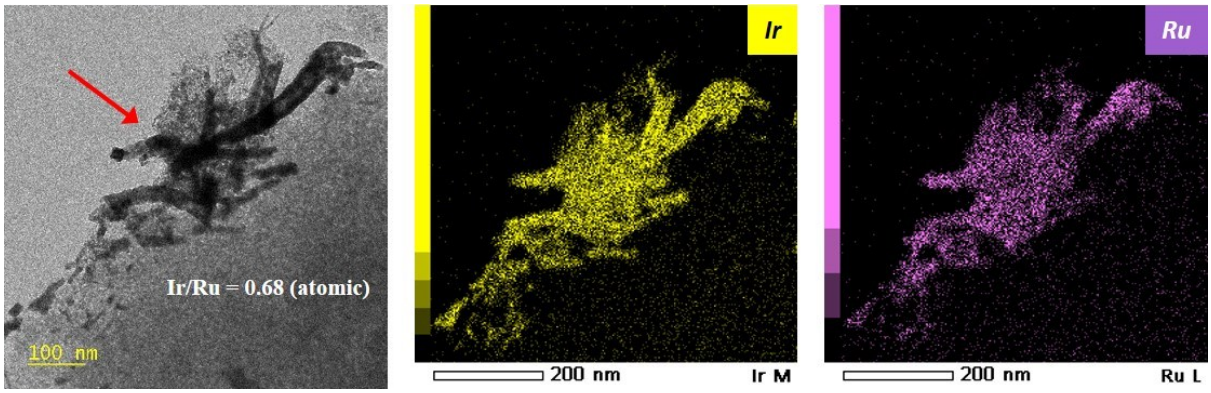

Fig. S8. An exemplary EDX mapping of a large-sized agglomerate (marked with a red arrow) observed on the surface of reduced bimetallic IrRu samples.

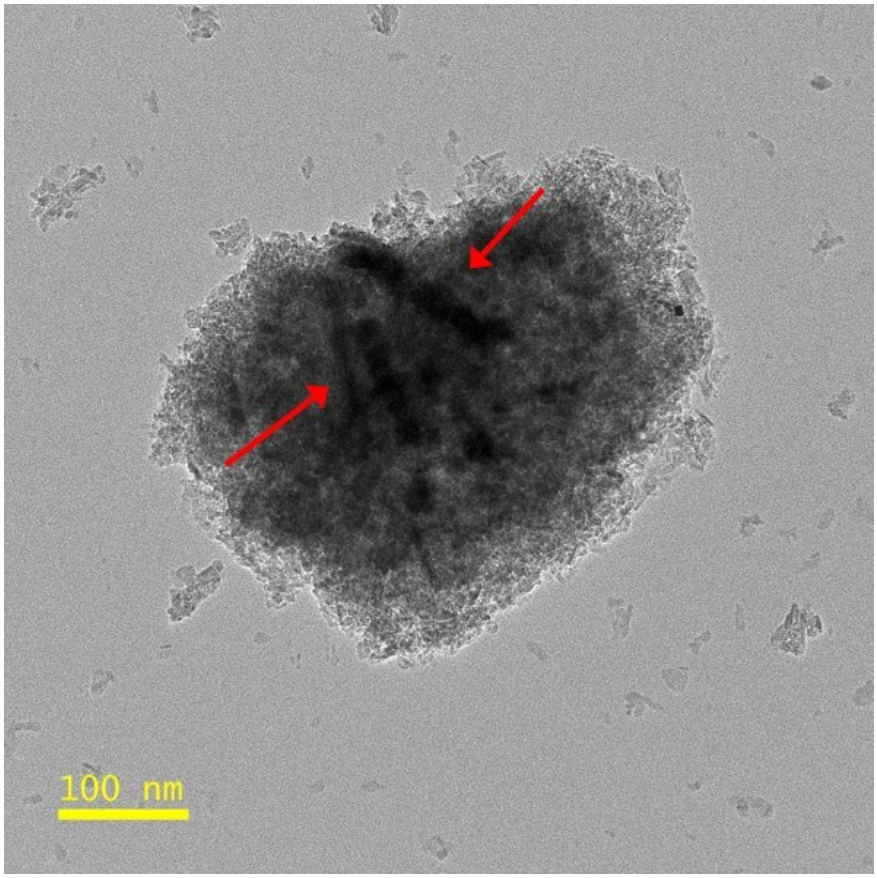

Fig. S9. TEM image of bimetallic IrRu sample after calcination (under air, at 500 °C for 4 h). The presence of agglomerates are marked with red arrows.

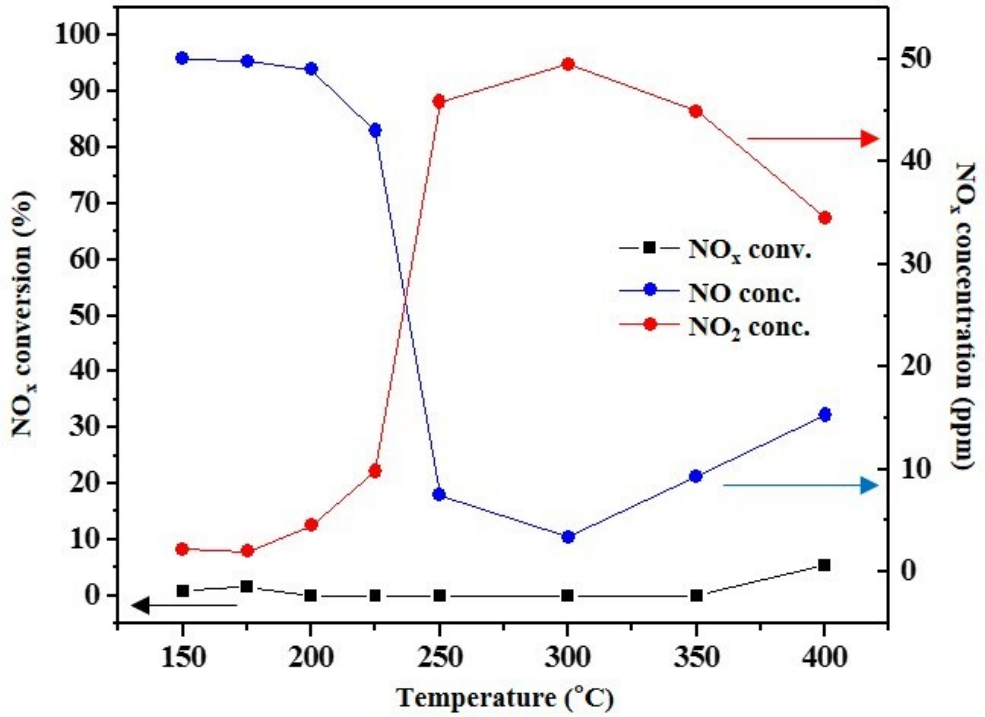

Fig. S10. NO concentration (blue line), NO_2 concentration (red line), and NO_x conversion (black line) during standard NO_x reduction reaction over reduced Ir0Ru4 catalyst. Right-side of the y-axis indicate NO/NO_2 concentrations, and left-side of the y-axis indicate NO_x conversion.