Electric Supplementary Information (ESI)

Drastic change in selectivity caused by addition of oxygen to the hydrogen stream for the hydrogenation of nitrite in water over a supported platinum catalyst

Jun Hirayama,[a] Kei-ichiro Yasuda,[b] Sayaka Misu,[b] Ryoichi Otomo[a] and Yuichi Kamiya[a*]

[a]*Faculty of Environmental Earth Science, Hokkaido University, Nishi 5, Kita 10, Kita-ku, Sapporo 060-0810, Japan*

[b]*Graduate School of Environmental Science, Hokkaido University, Nishi 5, Kita 10, Kita-ku, Sapporo 060-0810, Japan*

*Corresponding author

Yuichi Kamiya

E-mail: kamiya@ees.hokudai.ac.jp, Tel/Fax:+81-11-706-2217

Table S1 Physical properties of Al_2O_3-supported catalysts

Catalyst[a]	S_{BET}[b] /m^2 g^{-1}	Particle size /nm	
		TEM[c]	CO[d]
Pt/Al_2O_3	101	2.4 ± 0.5	4.1
Pd/Al_2O_3	112	2.8 ± 0.7	4.0
Ir/Al_2O_3	113	1.7 ± 0.6	2.3
Ru/Al_2O_3	117	3.1 ± 0.7	3.3
Rh/Al_2O_3	98	3.3 ± 0.9	3.9

[a] Loading amount of metal was 0.3 mmol g^{-1}.

[b] Specific surface areas were calculated from the N_2 adsorption isotherm taken at 77 K to BET (Brunauer–Emmett–Teller) theory.

[c] Particle size estimated from TEM images, which are given in Fig. S1.

[d] Particle size estimated from CO-pulse titration at 323 K.

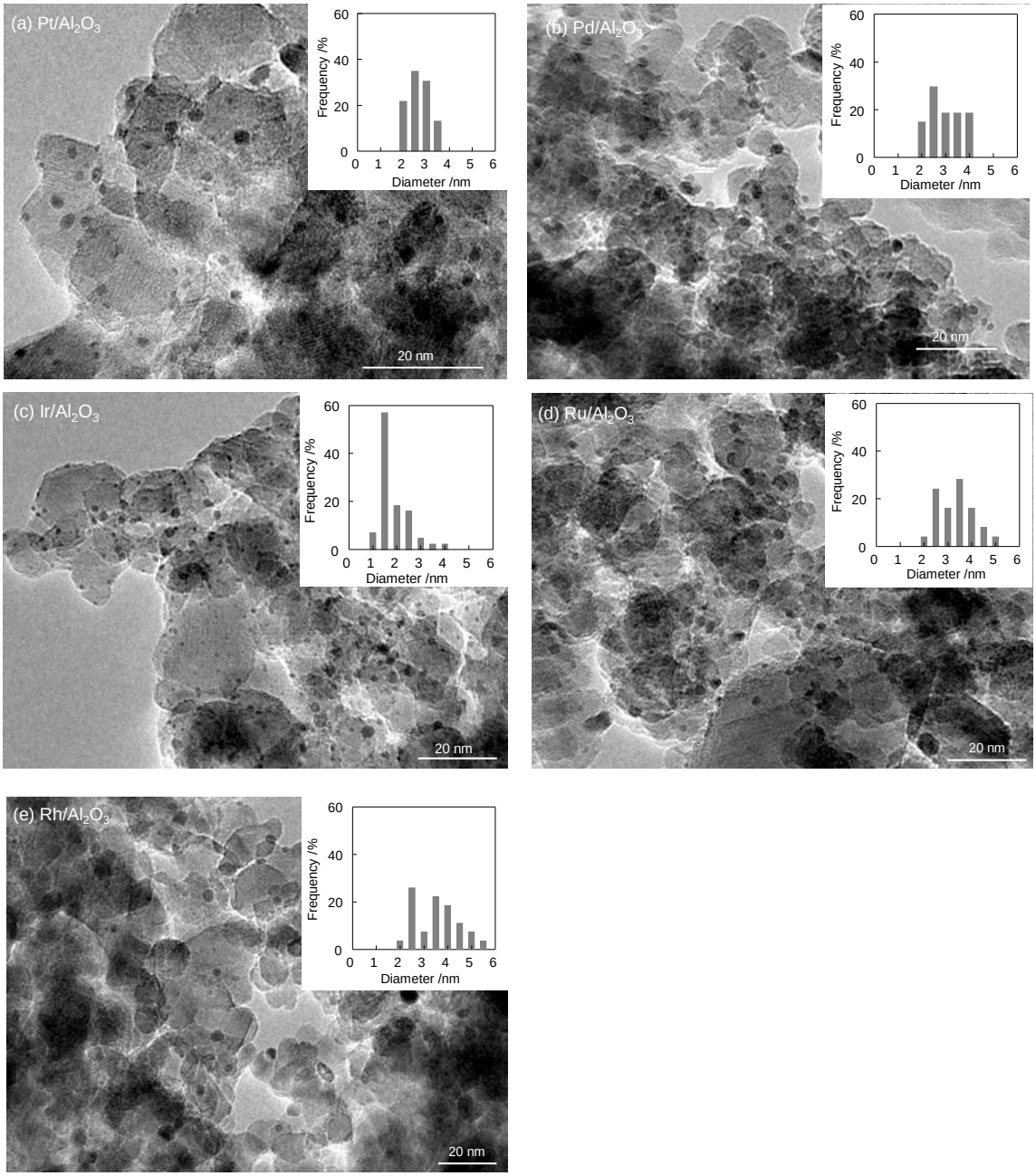

Figure S1 TEM images of (a) Pt/Al_2O_3, (b) Pd/Al_2O_3, (c) Ir/Al_2O_3, (d) Ru/Al_2O_3, and (e) Rh/Al_2O_3. Inset: distributions of metal particle sizes.

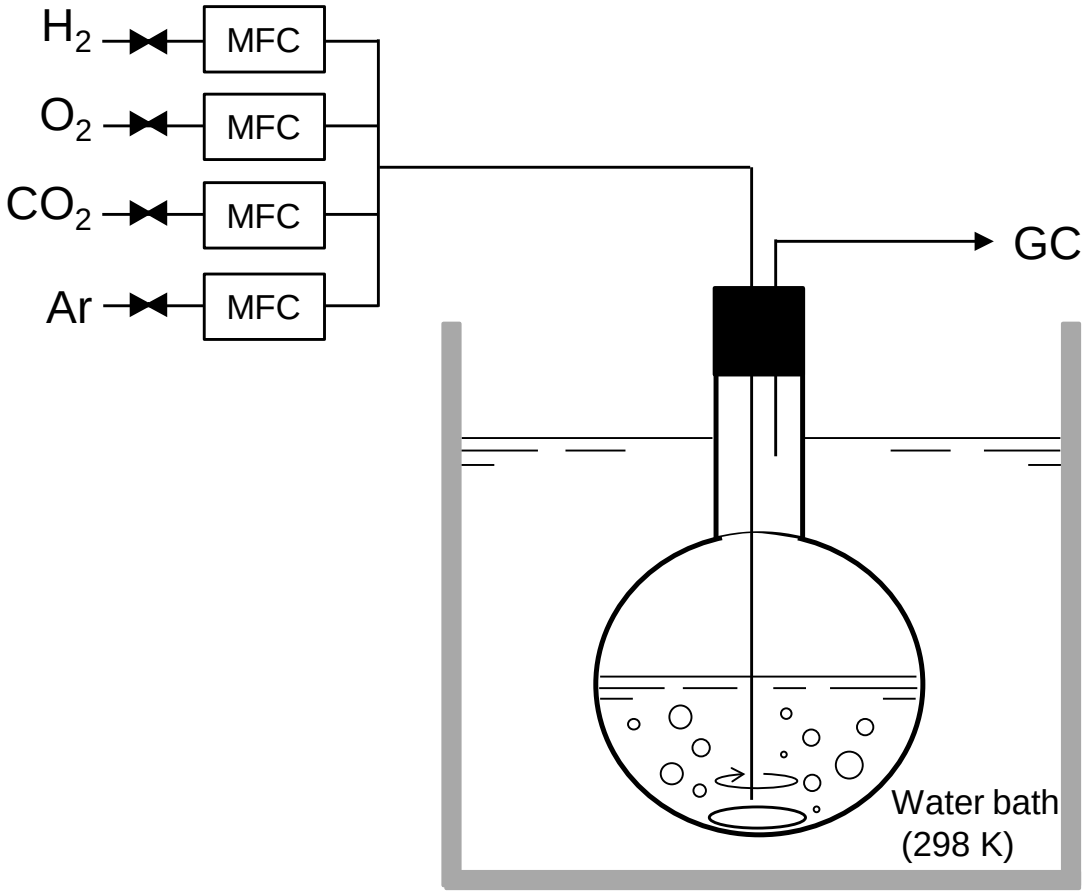

Figure S2 Schematic illustration of the catalytic reaction system. *Because of the high risk of H_2-O_2 mixture for explosion, catalytic reaction experiments should be performed meticulously.

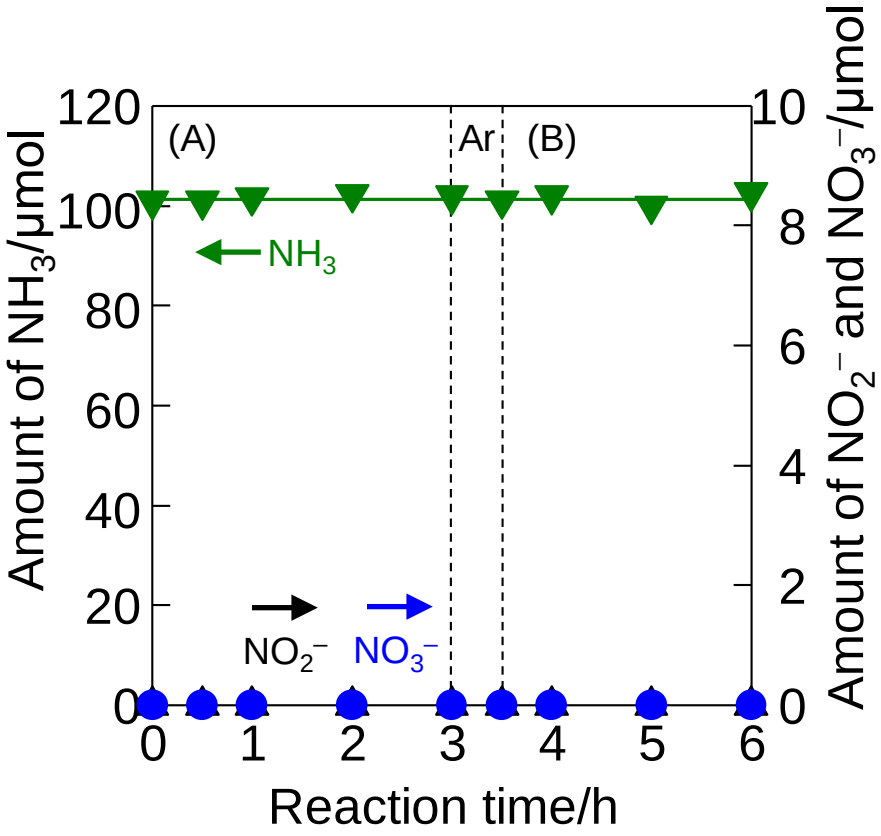

Figure S3 Time courses for the amounts of NH_3, NO_2^-, and NO_3^- in the solution during the oxidation of NH_3 with O_2 over Pt/Al_2O_3 (A) in the presence and (B) absence of H_2. Reaction conditions: concentration of NH_3, 1.0 mmol dm^{-3}; volume of reaction solution, 100 cm^3; source of ammonium ion, NH_4Cl; total pressure, 1.0 atm; gas composition, (A) H_2:O_2:CO_2:Ar = 2:1:3:4 and (B) O_2:CO_2:Ar = 1:3:6; gas flow rate, 100 cm^3 min^{-1}; and reaction temperature, 298 K.

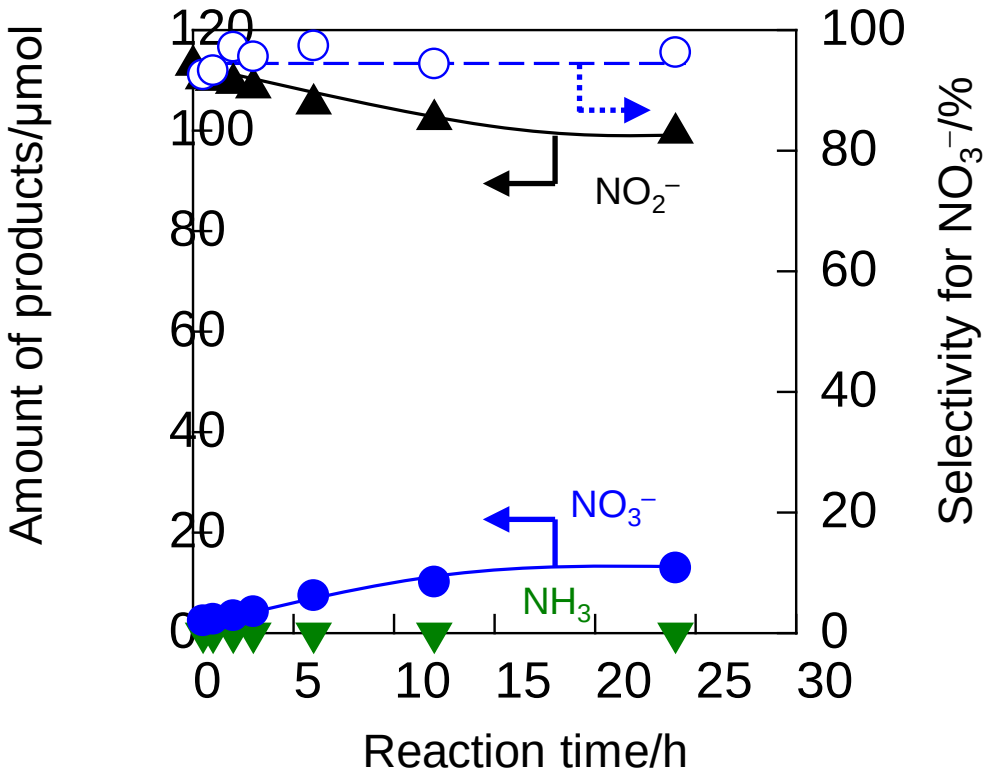

Figure S4 Time courses for the amounts of NO_2^-, NO_3^-, and NH_3, and selectivity for NO_3^- for the oxidation of NO_2^- with O_2 in water over Pt/Al_2O_3 in the absence of H_2. Reaction conditions: concentration of NO_2^-, 1.0 mmol dm^{-3}; volume of reaction solution, 100 cm^3; total pressure, 1.0 atm; source of NO_2^-, KNO_2; gas composition, O_2:CO_2:Ar = 2:3:5; gas flow rate, 100 cm^3 min^{-1}; and reaction temperature, 298 K.

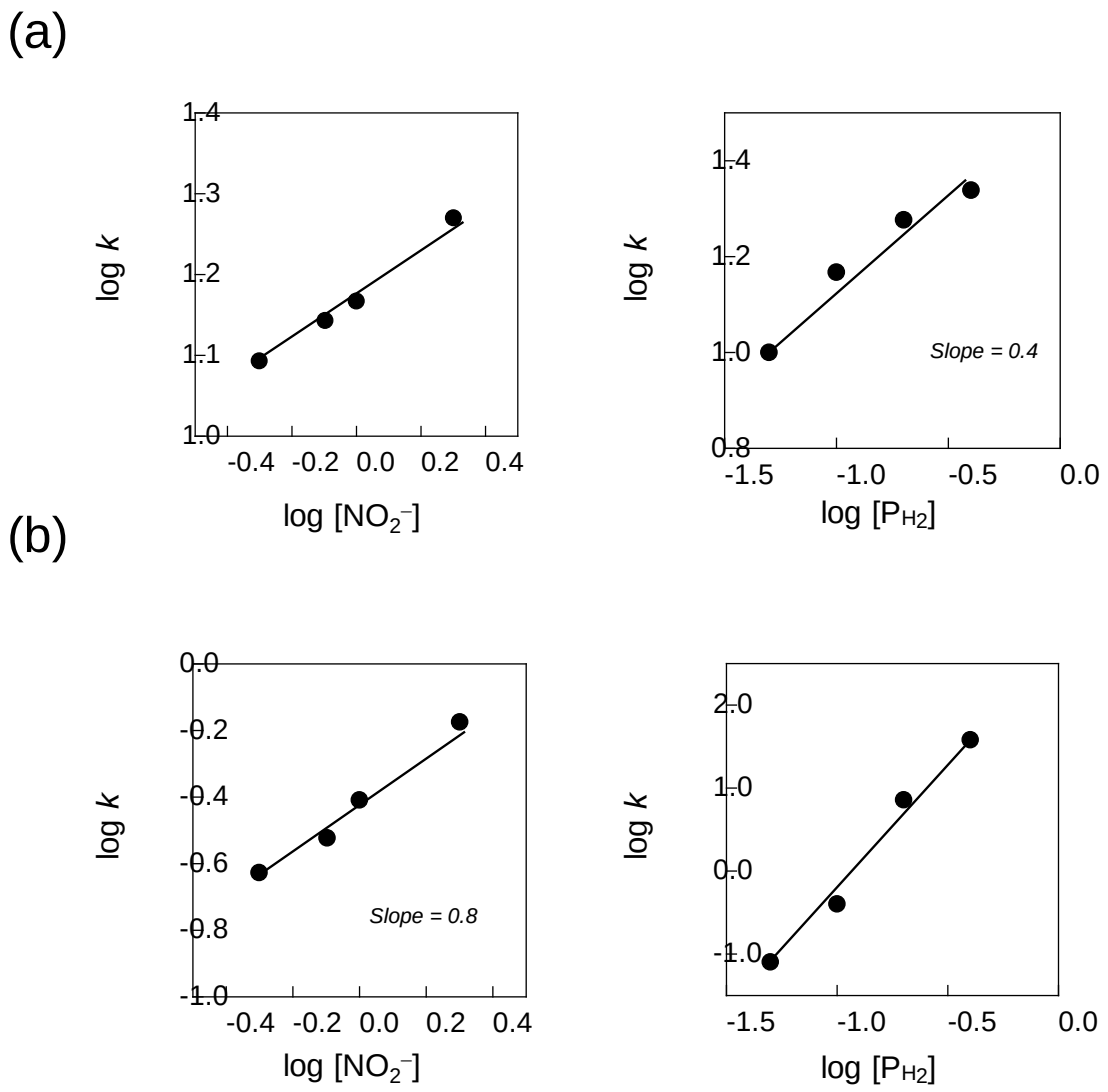

Figure S5 Log-log plots for NO_2^- decomposition rates in the catalytic hydrogenation of NO_2^- over Pt/Al_2O_3 in the (a) absence and (b) presence of O_2. Reaction conditions: reactant NO_2^- (from KNO_2), 0.5–2.0 mmol dm^{-3}; reaction volume, 250 cm^3; partial pressure of H_2, P_{H2} = 0.1–0.4 atm; and gas flow rate, 30 cm^3 min^{-1}. For the reaction in the absence of O_2, P_{H2} was fixed at 0.1 atm. On the other hand, concentration of NO_2^- and partial pressure of O_2 were fixed at1.0 mmol dm^{-3} and 0.1 atm, respectively.