

Supplementary information for

Simultaneous removal of nitrite and ammonia as dinitrogen in aqueous suspensions of a titanium(IV) oxide photocatalyst under reagent-free and metal-free conditions at room temperature

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1. Experimental

1.1. Materials

All chemicals were used without further purification. Evonik P25 TiO₂ particles were used as a TiO₂ photocatalyst. Other metal oxides and metal double oxides were supplied by Wako Chemicals (SrTiO₃, BaTiO₃, α -Fe₂O₃, FeTiO₃, SnO₂, β -SiC), Kanto Chemicals (Co₃O₄, MoO₃, Ta₂O₅, BiVO₄, Bi₂O₃, NiO, ZnO, CeO₂, In₂O₃, CuO, Sn-doped In₂O₃ (ITO), Nb₂O₅, MnO₂, γ -Fe₂O₃), Kishida Chemical (ZnTiO₃) and Kojundo Chemical Laboratory (WO₃).

1.2. Photocatalytic reaction

Bare TiO₂ particles (50 mg) were suspended in a solution (5 cm³) containing sodium nitrite (500 μ mol, Kanto Chemicals) and ammonium sulfate (250 μ mol) in a test tube. The pH of the suspension was adjusted to 7 using sodium hydroxide solution. The tube was sealed with a rubber septum and then photoirradiated at $\lambda > 300$ nm with a mercury arc under Ar with magnetic stirring (1000 rpm) in a water bath continuously kept at 298 K. Concentrations of NO₂⁻ and nitrate (NO₃⁻) in the liquid phase were determined with a Jasco PU-2800 plus ion chromatograph equipped with an ICNI-424 column (Shodex, Japan). The concentration of NH₃ (in the form of NH₄⁺) in the liquid phase was determined with a Jasco PU-2800i plus ion chromatograph equipped with an YS-50 column (Shodex, Japan). The amounts of dinitrogen (N₂), dinitrogen monoxide (N₂O) and hydrogen (H₂) in the gas phase of reaction mixtures were measured using a Shimadzu GC-8A gas chromatograph equipped with an MS-5A column.

1.3. Apparent quantum efficiency (AQE) measurement

To obtain AQE in the reaction system, a UV light-emitting diode (UV-LED, POT-365, Asahi Spectra Co.,Ltd, 3.23 mW cm^{-2} , maximum energy at $\lambda = 365 \text{ nm}$) was also used as a light source. A spectrum and light intensity of the UV-LED were determined using a spectroradiometer (USR-45D, Ushio, Tokyo).

2. Results

2.1. Reactions over various metal (double) oxides

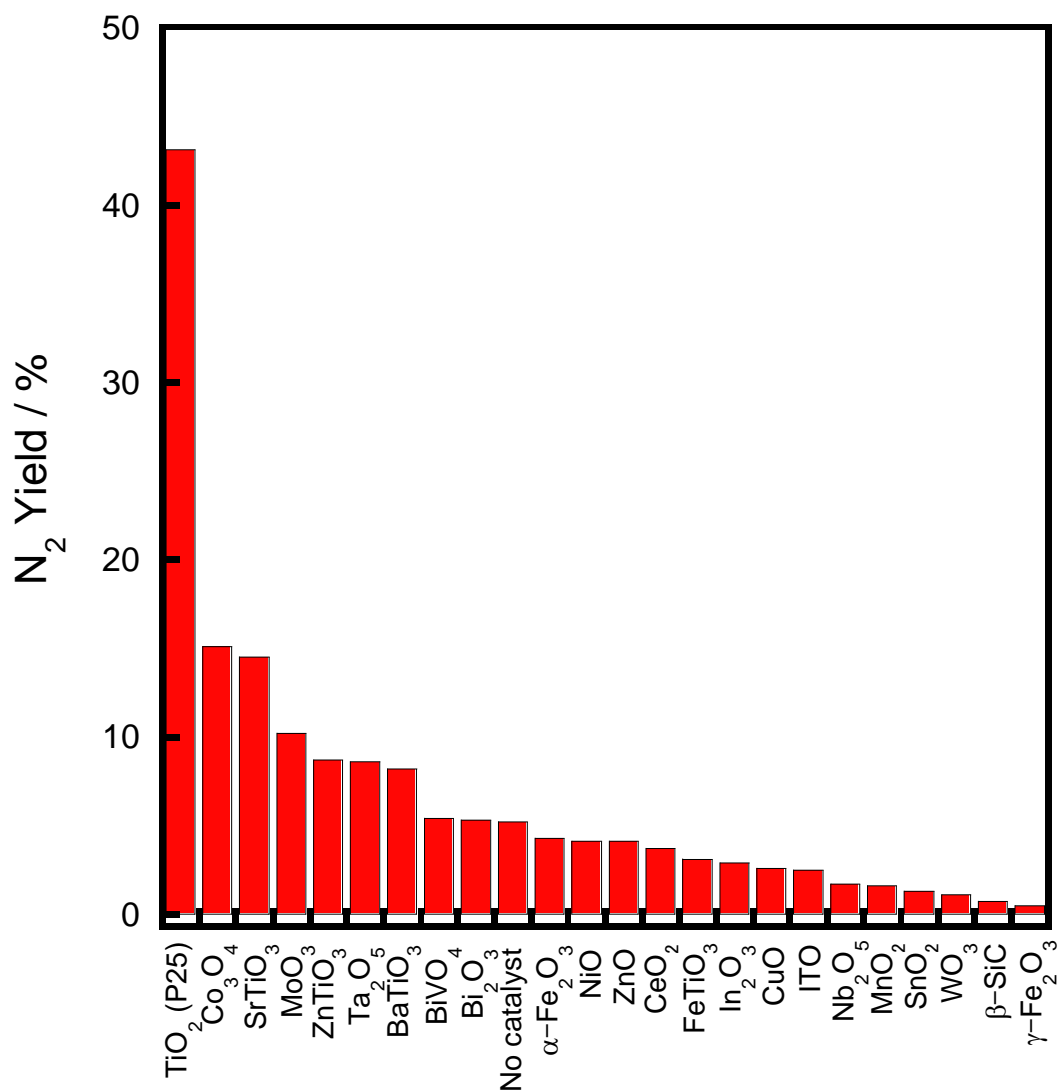


Fig. S1 Yield of N₂ in photocatalytic reduction of NO₂⁻ in aqueous suspensions of various metal-free metal (double) oxides in the presence of NH₃⁺ at pH 7 under irradiation of UV light for 5 h at 298 K.