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

Supplementary Information for

Rutile Titanium Dioxide Prepared by Hydrogen Reduction of Degussa P25 for Highly Efficient Photocatalytic Hydrogen Evolution

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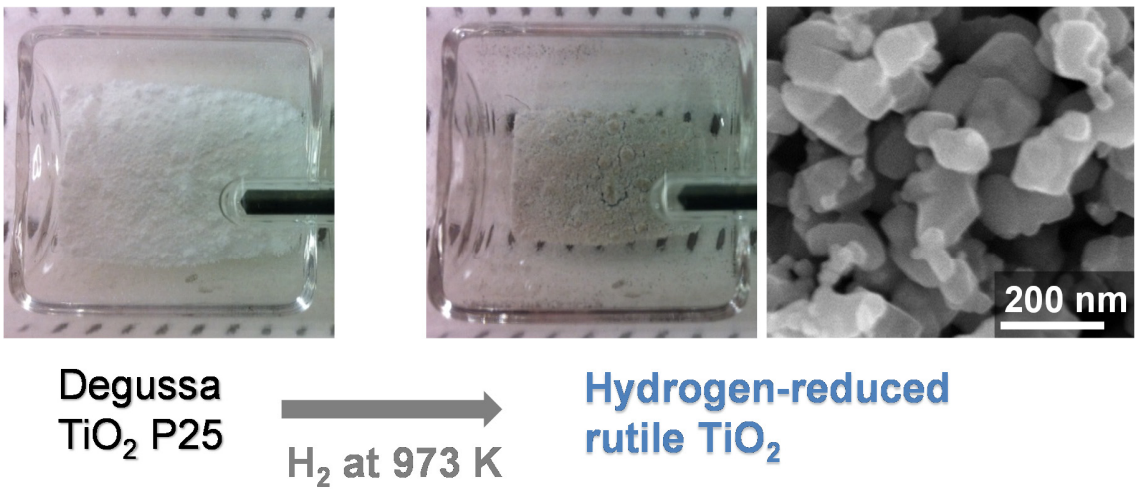

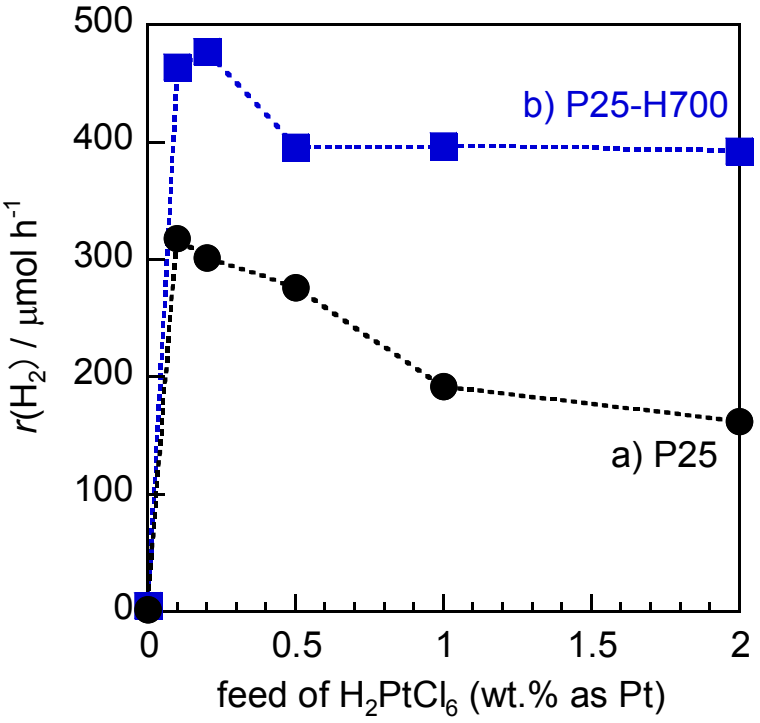

Figure S1. Effect of Pt loading (feed of $H_2[PtCl_6]$) on the rate of photocatalytic H_2 evolution from 50 vol.% aqueous ethanol solutions over (a) P25 and (b) P25-H700 with Pt under 380-nm irradiation.

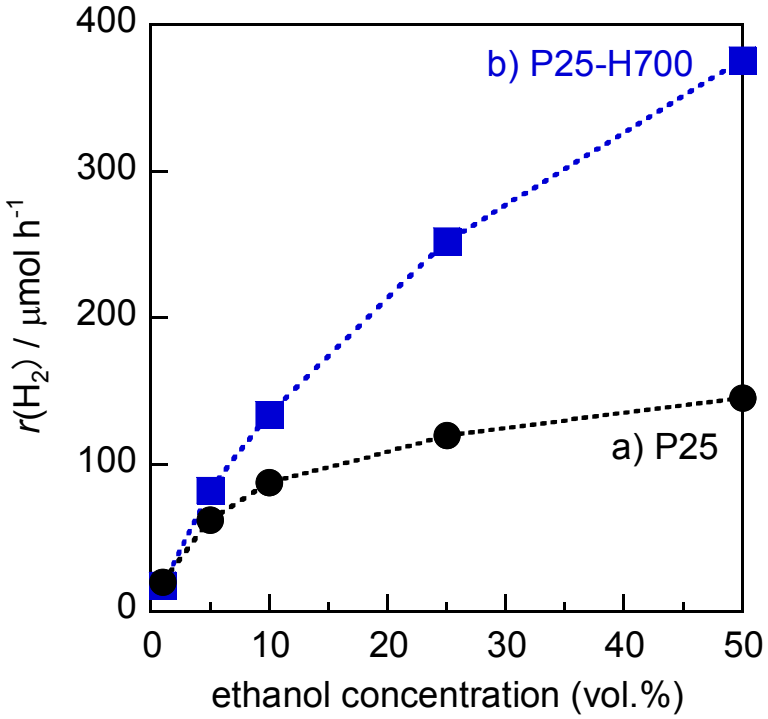

Figure S2. Effect of ethanol concentration on the rate of photocatalytic H_2 evolution from aqueous ethanol solutions over (a) P25 and (b) P25-H700 with 2.0 wt.% Pt under 380-nm irradiation.

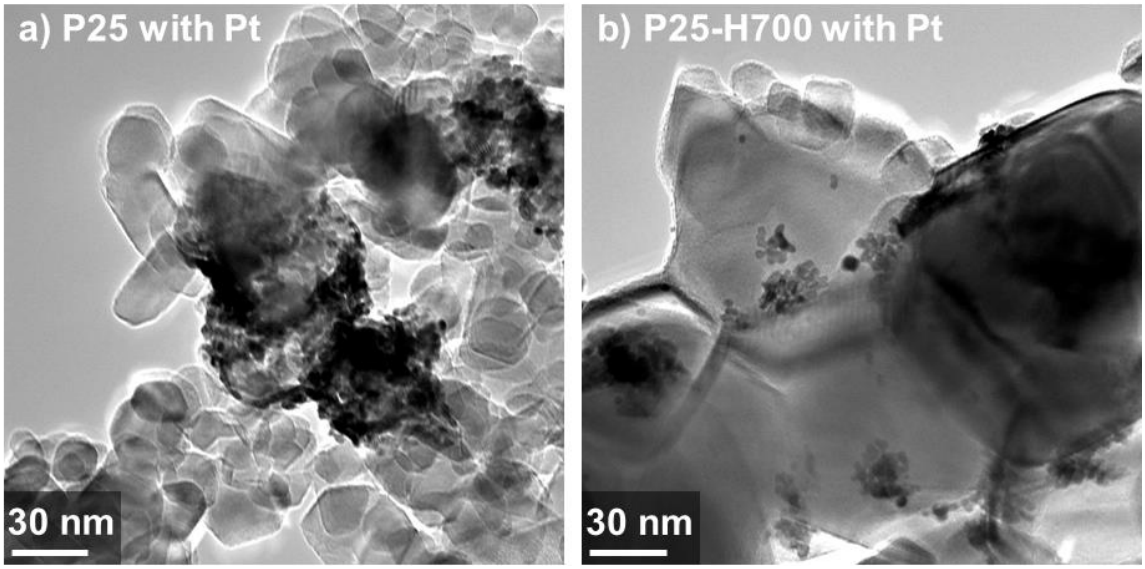

Figure S3. TEM images of (a) P25 and (b) P25-H700 with 2.0 wt.% Pt after photocatalytic H_2 evolution from 50 vol.% aqueous ethanol solutions under 380-nm irradiation.

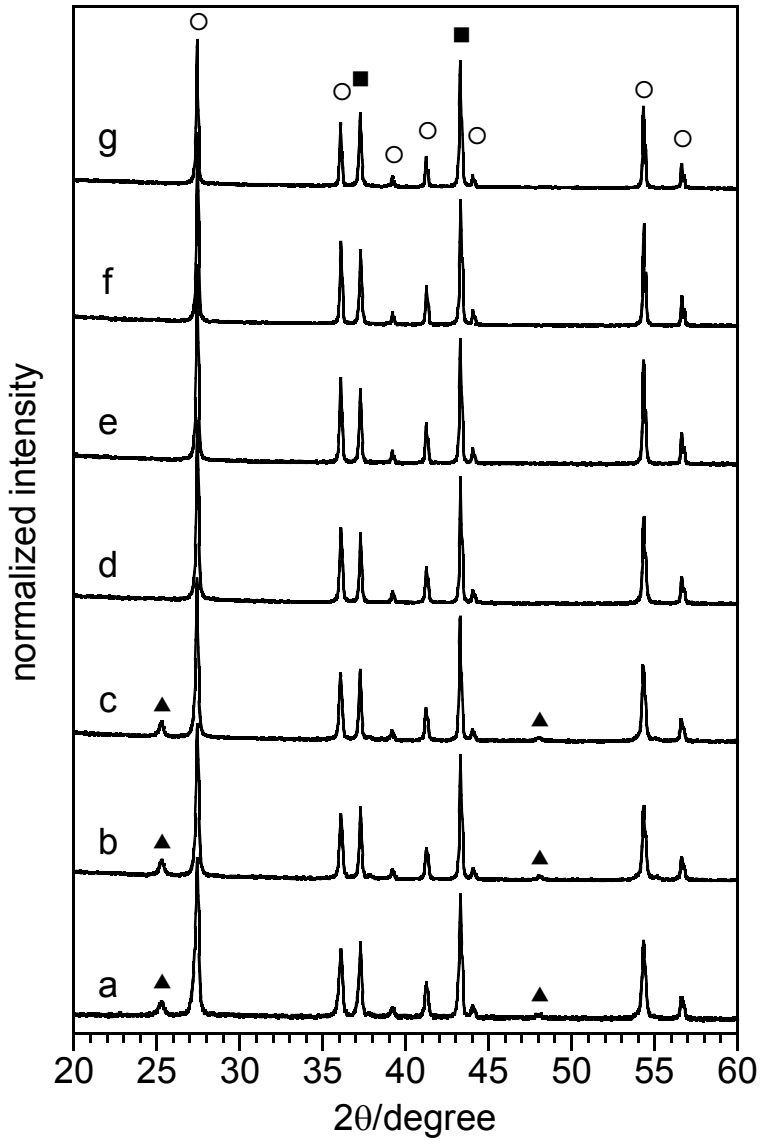

Figure S4. XRD patterns of H_2-reduced TiO_2 after calcination at (a) 300 °C, (b) 500 °C, (c) 700 °C, (d) 800 °C, (e) 900 °C, (f) 1000 °C, and (g) 1100 °C: (▲) anatase TiO_2, (○) rutile TiO_2, and (■) internal standard NiO. The TiO_2 was first calcined and then reduced with H_2 at 700 °C.

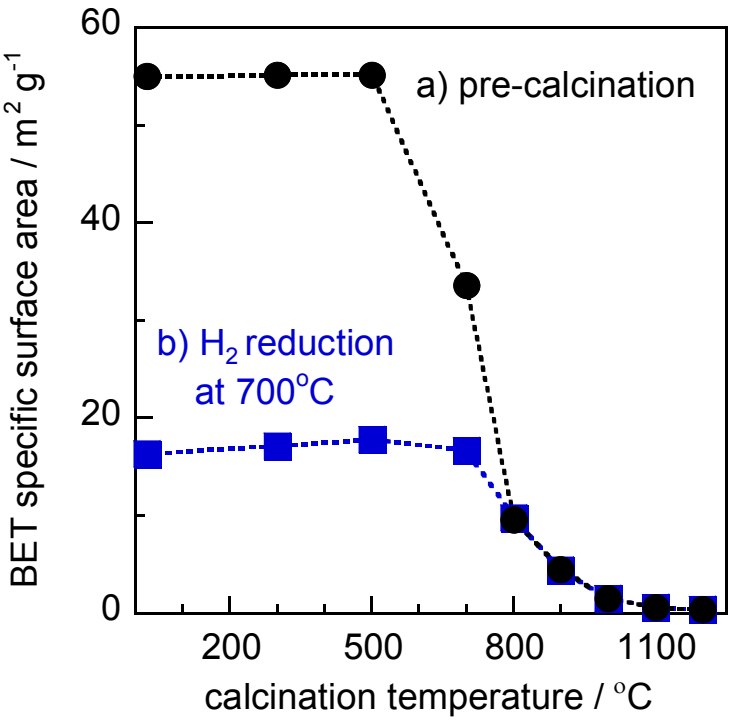

Figure S5. BET specific surface area of (a) TiO_2 P25 calcined at different temperatures, and (b) TiO_2 reduced with H_2 at 700°C after calcination.

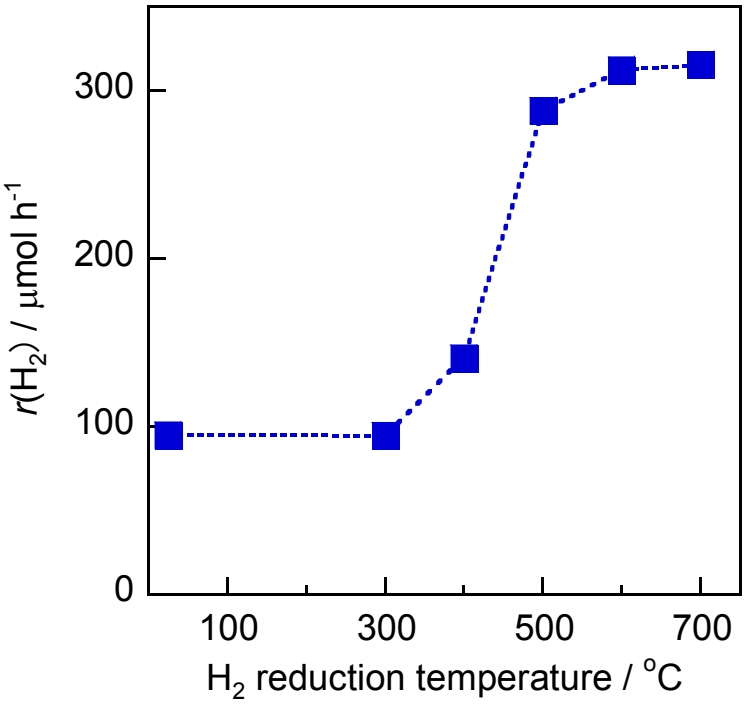

Figure S6. Effect of H_2 treatment temperature on the rate of photocatalytic H_2 evolution over phase-pure rutile P900 (Photocatalyst: 50 mg TiO_2. Solution: 50 vol.% aqueous ethanol solutions containing H_2PtCl_6 corresponding to 2.0 wt.% Pt, 9.0 mL. Light source: 380-nm LEDs). P900 denotes TiO_2 P25 calcined at 900°C.

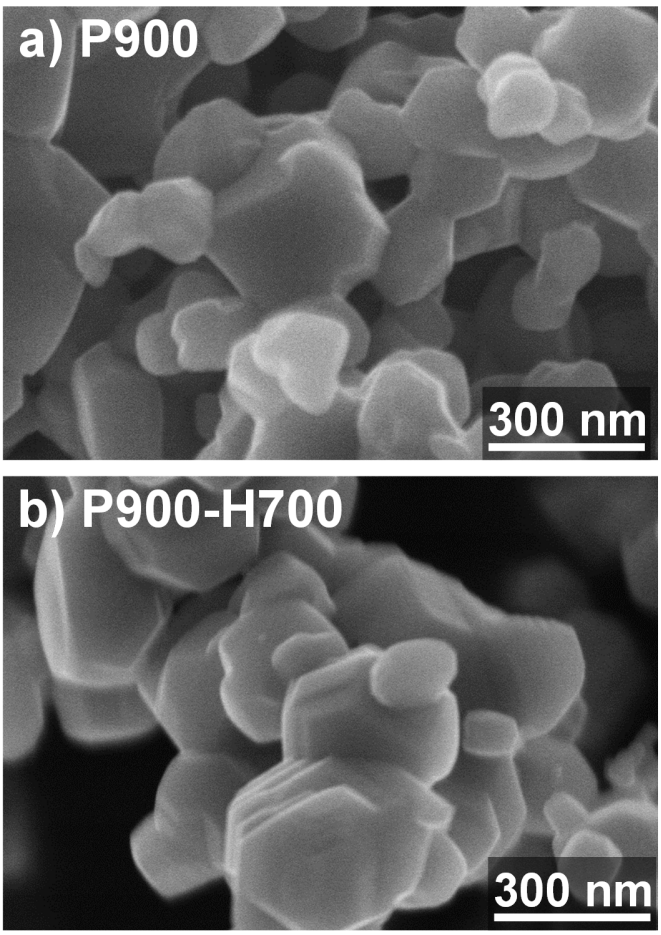

Figure S7. SEM images of (a) P900, and (b) P900 reduced with H_2 at 700°C, denoted as P900-H700. BET specific surface area was measured to be 4.5 $m^2 g^{-1}$ for P900 and 4.4 $m^2 g^{-1}$ for P900-H700. The average particle diameters were estimated to be about 320 nm from their BET specific surface areas using theoretical density of rutile TiO_2 (4.25 g cm^{-3}) assuming every particle is a sphere.

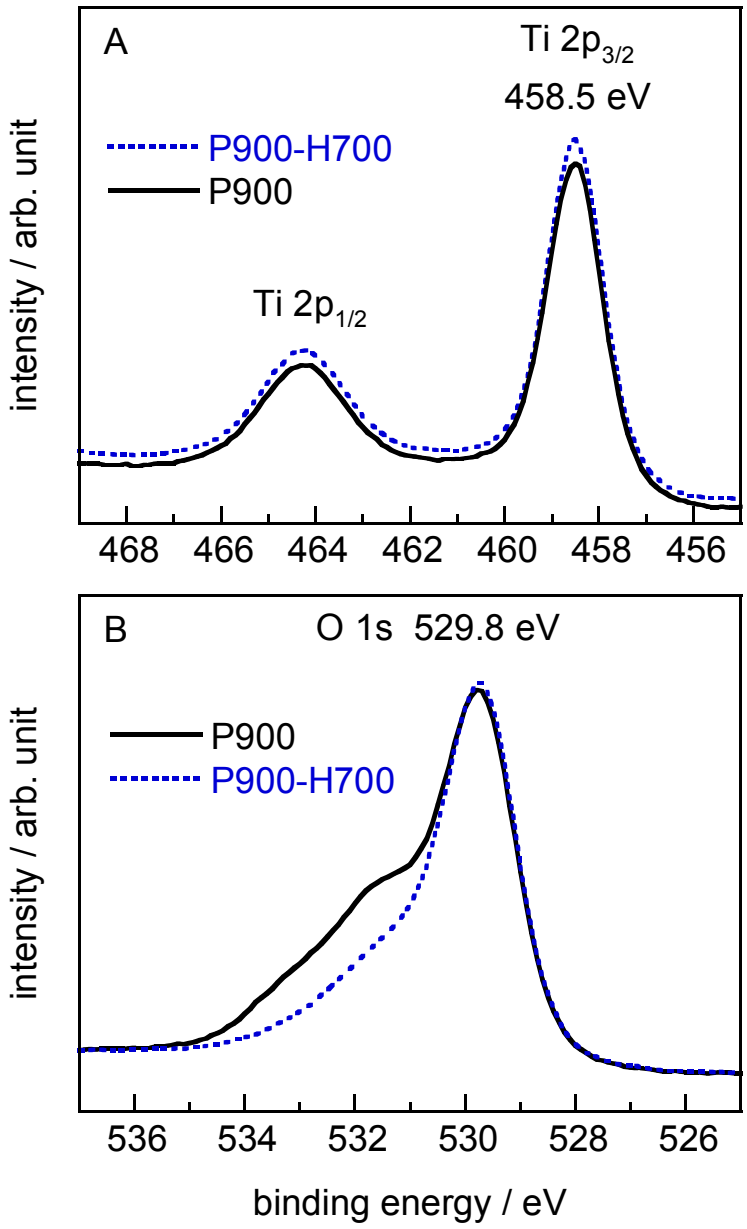

Figure S8. (A) Ti 2p X-ray photoelectron spectra (XPS) of P900 and P900-H700. The binding energy of 458.5 eV for Ti $2p_{3/2}$ is similar to the literature value for Ti^{4+} in TiO_2. This indicates that the amount of Ti^{3+} ions is small on the surface of H_2-reduced TiO_2. (B) O 1s XPS of P900 and P900-H700. The peak at 529.8 eV is assigned to lattice oxygen of TiO_2.

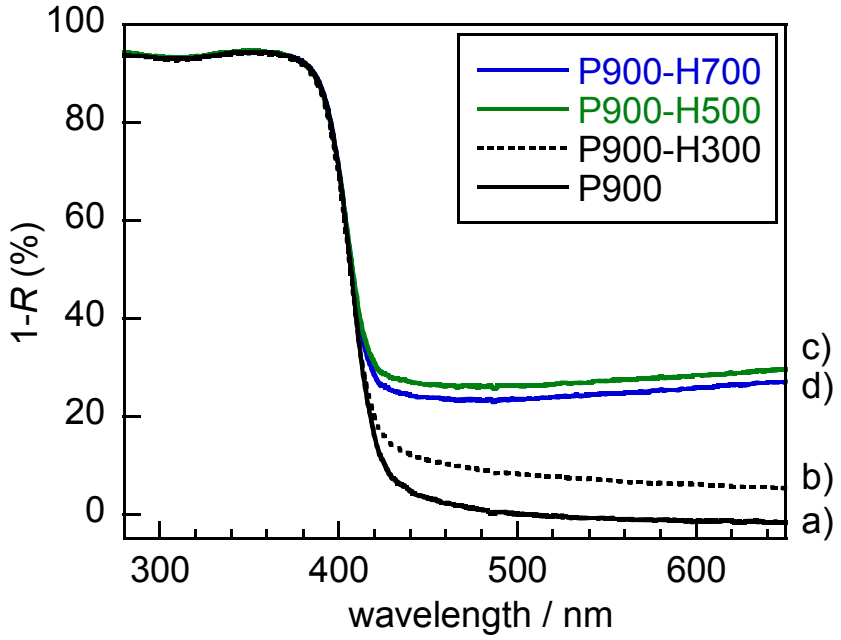

Figure S9. Diffuse reflectance UV-visible absorption spectra of (a) P900, (b) P900-H300, (c) P900-H500, and (d) P900-H700.

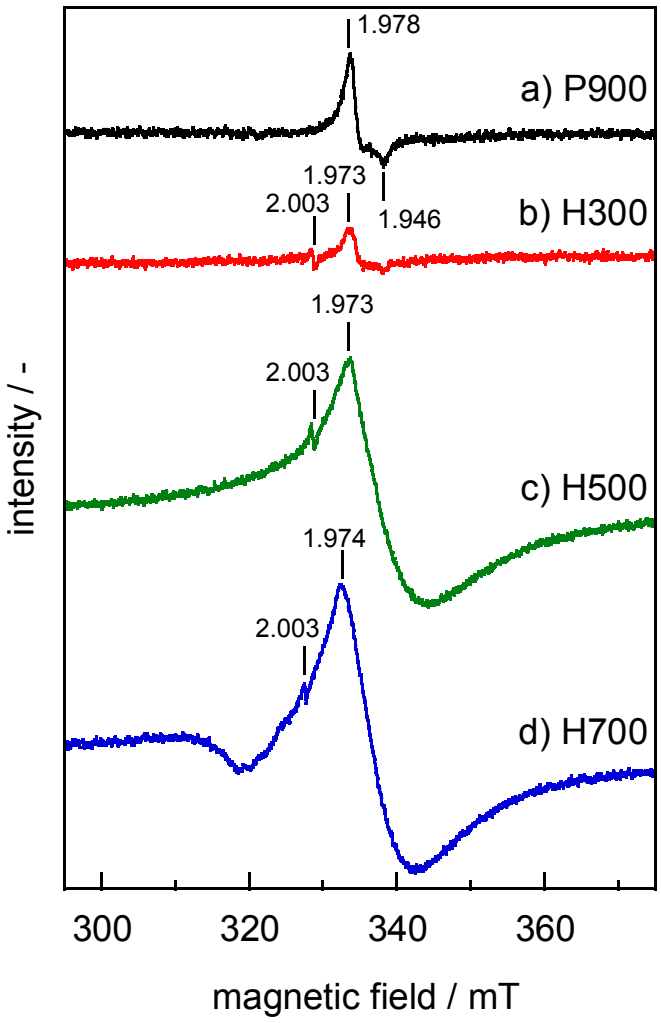

Figure S10. ESR spectra of TiO_2 particles monitored at −150 °C in the dark. (a) P900, (b) P900-H300, (c) P900-H500, and (d) P900-H700.