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

$ZnTa_2O_6$ photocatalyst synthesized via solid state reaction for conversion of CO_2 into CO in water

Corresponding authors

Prof. Kentaro Teramura and Prof. Tsunehiro Tanaka

Department of Molecular Engineering, Graduate School of Engineering, Kyoto University, Kyotodaigaku Katsura, Nishikyo-ku, Kyoto 615−8510, Japan

Tel: +81−75−383−2559 Fax: +81−75−383−2561

E–mail address: teramura@moleng.kyoto-u.ac.jp

List of the authors

Shoji Iguchi[a], Kentaro Teramura[a,b*], Saburo Hosokawa[a,b], and Tsunehiro Tanaka[a,b*]

Affiliation and full postal address

a. Department of Molecular Engineering, Graduate School of Engineering, Kyoto University, Kyotodaigaku Katsura, Nishikyo-ku, Kyoto 615−8510, Japan

b. Elements Strategy Initiative for Catalysts & Batteries (ESICB), Kyoto University, 1-30 Goryo-Ohara, Nishikyo-ku, Kyoto 615−8245, Japan

Fabrication of film form $ZnTa_2O_6$ for electrochemical measurement

The film form $ZnTa_2O_6$ samples were prepared by an electrophoresis method. The photocatalyst powder was dispersed to an acetone solution containing iodine (I_2) as an electrolyte, and 10 V of a direct current (DC) was applied to the suspension using a two-electrode electrochemical cell to deposit the photocatalyst on a glass substrate covered with fluorine-doped tin oxide (FTO) as a conductive layer. The prepared film sample, hereinafter called $ZnTa_2O_6$/FTO, was heated at 773 K for 2 h before use.

Electrochemical measurement

The photoelectrochemical measurement was performed in a three-electrode type cell; $ZnTa_2O_6$/FTO, Ag/AgCl electrode, Pt wire, and 0.1 M Na_2SO_4 aq. were used as working electrode, reference electrode, counter electrode, and electrolyte solution, respectively. The $ZnTa_2O_6$/FTO electrode was irradiated with a 200 W Hg-Xe lamp (San-ei electric) through a quartz window under N_2 atmosphere without external bias, and the value of phorocurrent was recorded by using an electrochemical measurement system (HZ-5000, Hokuto Denko Corp.). The irradiated area (effective area) of $ZnTa_2O_6$/FTO was fixed at 1 cm × 3 cm (3 cm^2) in the photoelectrochemical measurements in this study.

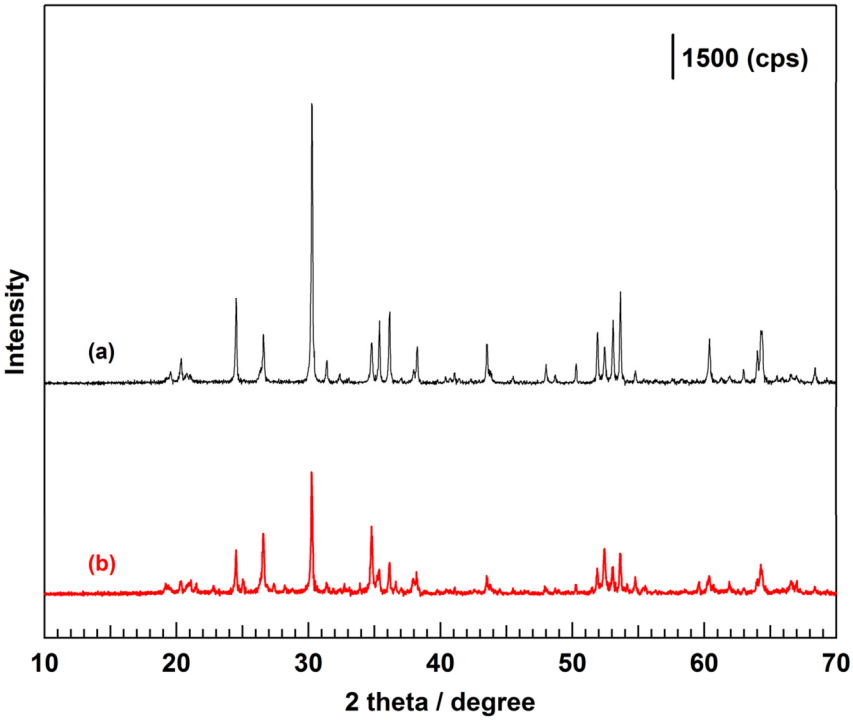

Figure S1 XRD patterns of (a) ZTO_1273 and (b) ZTO_PC.

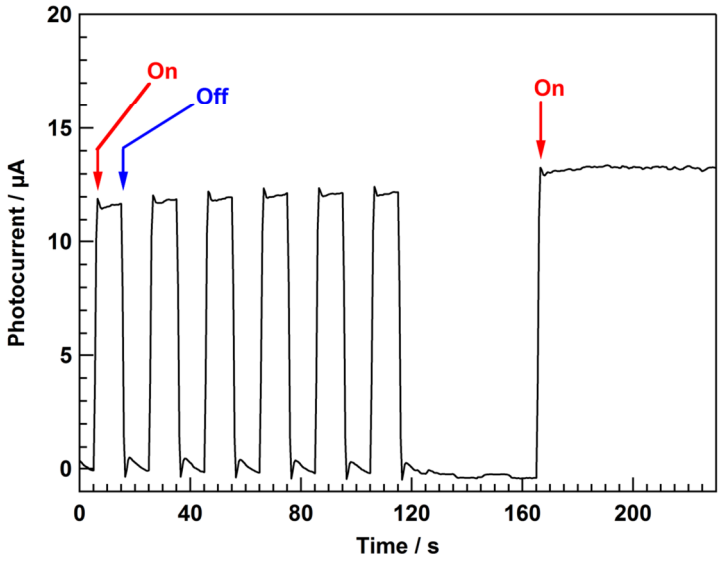

Figure S2 Photocurrent value of ZTO_1373 photoelectrode measured by using a three electrode type photoelectrochemical cell without external bias. Turning on and off of photoirradiation was repeated every 10 s from 0 to 120 s. UV-29 long-pass filter was used from 120 to 170 s. Photoirradiation was kept on after 170 s.

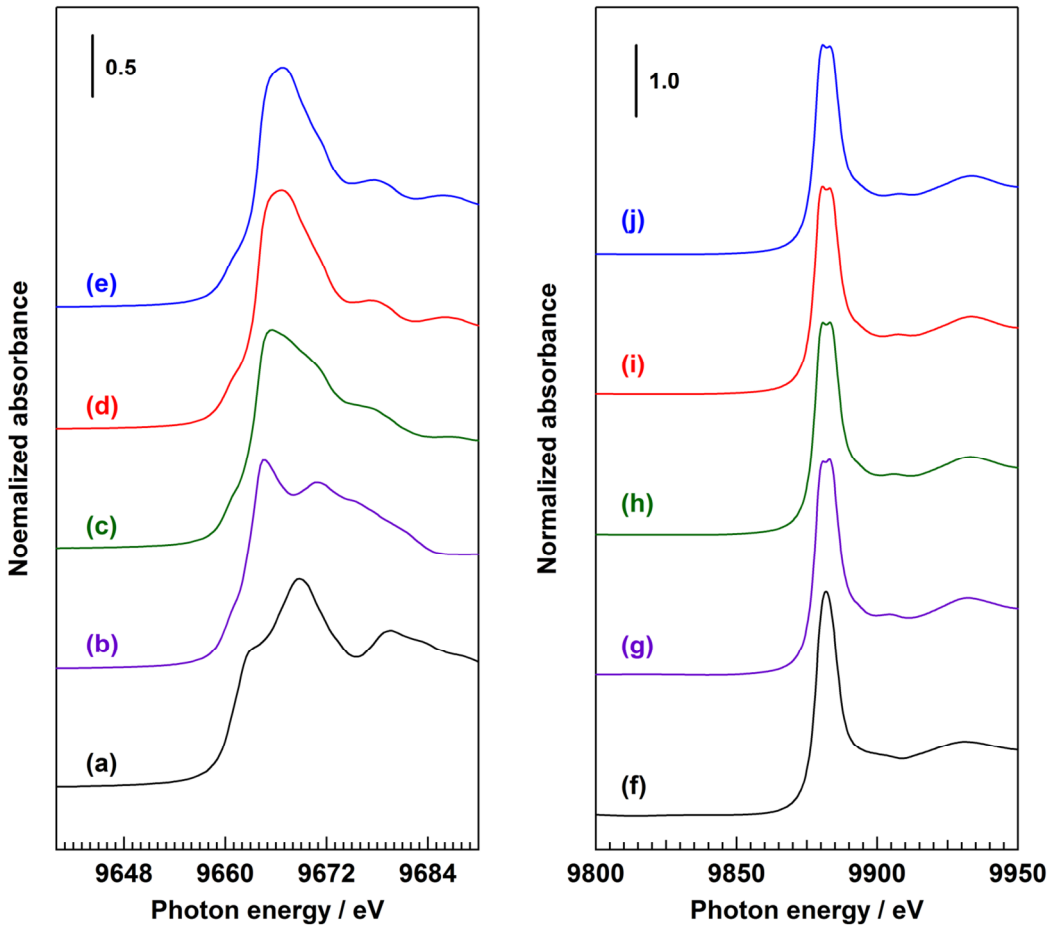

Figure S3 Normalized (a−e) Zn-K edge and (f−j) Ta-L_{III} edge XANES spectra of (a, f) mixture of ZnO and Ta_2O_5, (b, g) ZTO_1073, (c, h) ZTO_1173, (d, i) ZTO_1273, and (e, j) ZTO_1373.

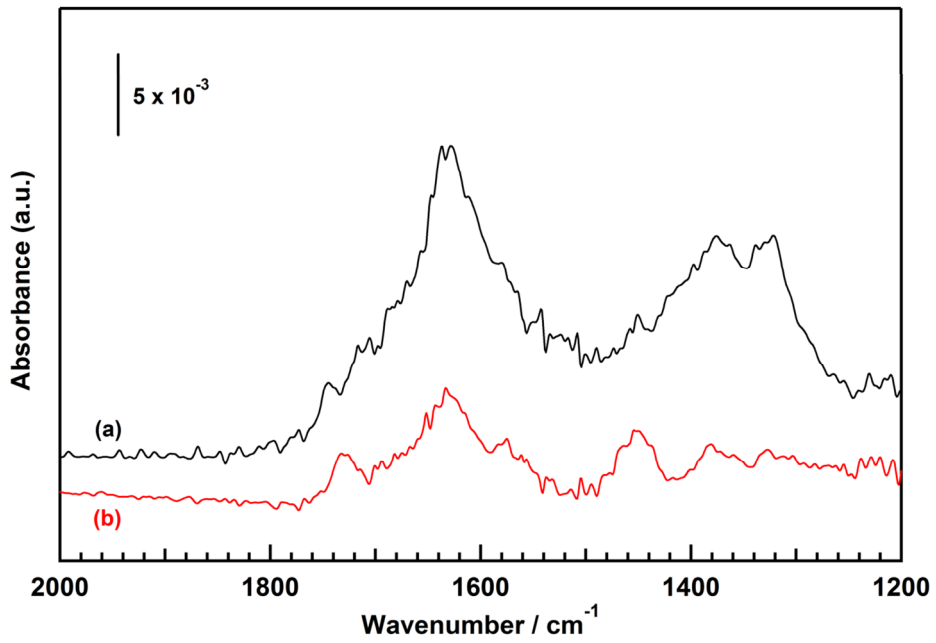

Figure S4 *In-situ* FT-IR spectra of (a) ZTO_1173 and (b) ZTO_1273.

Measurement mode: transmission, weight of palette: 100 mg, detector: MCT, resolution: 4 cm^{-1}, accumulation: 128 scans, temperature: R.T., pretreatment: O_2 treatment at 673 K for 60 min and evacuation at 673 K for 15 min, background spectrum: after pretreatment at R.T. under evacuation for each sample, CO_2 introduction: 1.1 kPa.