Electronic Supplementary Information

Tuning the selectivity toward CO evolution in the photocatalytic conversion of CO_2 by H_2O through the modification of Ag-loaded Ga_2O_3 with a $ZnGa_2O_4$ layer

Zheng Wang,[a] Kentaro Teramura,*[a,b,c] Zeai Huang,[a] Saburo Hosokawa,[a,b] Yoshihisa Sakata,[d] and Tsunehiro Tanaka*[a,b]

a Department of Molecular Engineering, Graduate School of Engineering, Kyoto University
Kyotodaigaku Katsura, Nishikyo-ku, Kyoto 615-8510, Japan
E-mail: teramura@moleng.kyoto-u.ac.jp
tanakat@moleng.kyoto-u.ac.jp

b Elements Strategy Initiative for Catalysts & Batteries (ESICB), Kyoto University
Kyotodaigaku Katsura, Nishikyo-ku, Kyoto 615–8520, Japan

c Precursory Research for Embryonic Science and Technology (PRESTO), Japan Science and Technology Agency (JST)
4-1-8 Honcho, Kawaguchi, Saitama 332-0012, Japan

d Graduate School of Science and Engineering, Yamaguchi University
2-16-1 Tokiwadai, Ube 755-8611, Japan

Table S1 The atomic ratio of Ag at the surface in each sample

Sample	The atomic ratio of Ag at the surface (Ag/Zn+Ga+O)
Ag(1.0 wt%)-loaded bare Ga_2O_3	5.1%
Ag(1.0 wt%)-loaded Zn(0.1 mol%)-modified Ga_2O_3	5.6%
Ag(1.0 wt%)-loaded Zn(0.5 mol%)-modified Ga_2O_3	4.9%
Ag(1.0 wt%)-loaded Zn(1.0 mol%)-modified Ga_2O_3	5.0%
Ag(1.0 wt%)-loaded Zn(3.0 mol%)-modified Ga_2O_3	5.0%
Ag(1.0 wt%)-loaded Zn(5.0 mol%)-modified Ga_2O_3	4.5%
Ag(1.0 wt%)-loaded Zn(10.0 mol%)-modified Ga_2O_3	4.2%

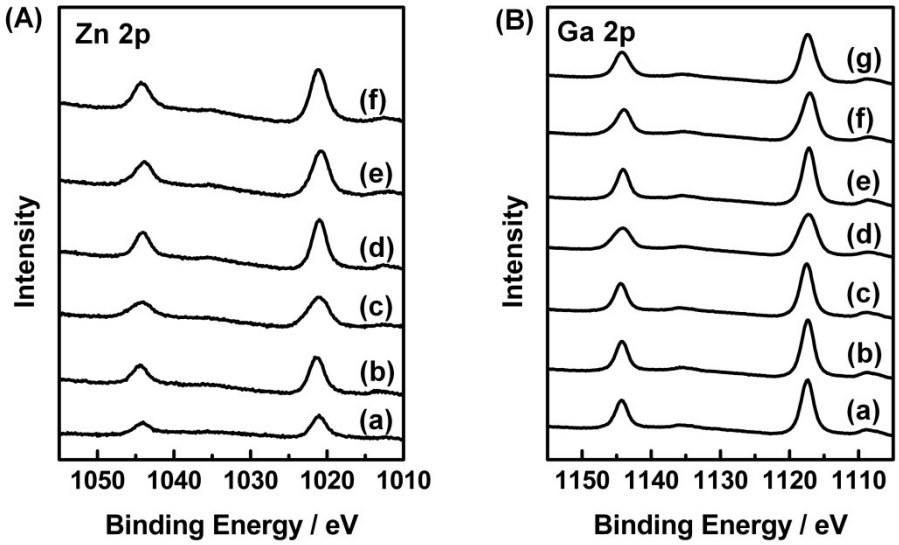

Figure S1 XPS Zn 2p line (A) for Zn-modified Ga_2O_3 with 0.1 mol% (a), 0.5 mol% (b), 1.0 mol% (c), 3.0 mol% (d), 5.0 mol% (e), and 10.0 mol% (f) of Zn species, and Ga 2p line (B) for bare Ga_2O_3 (a) and Zn-modified Ga_2O_3 with 0.1 mol% (b), 0.5 mol% (c), 1.0 mol% (d), 3.0 mol% (e), 5.0 mol% (f), and 10.0 mol% (g) of Zn species.

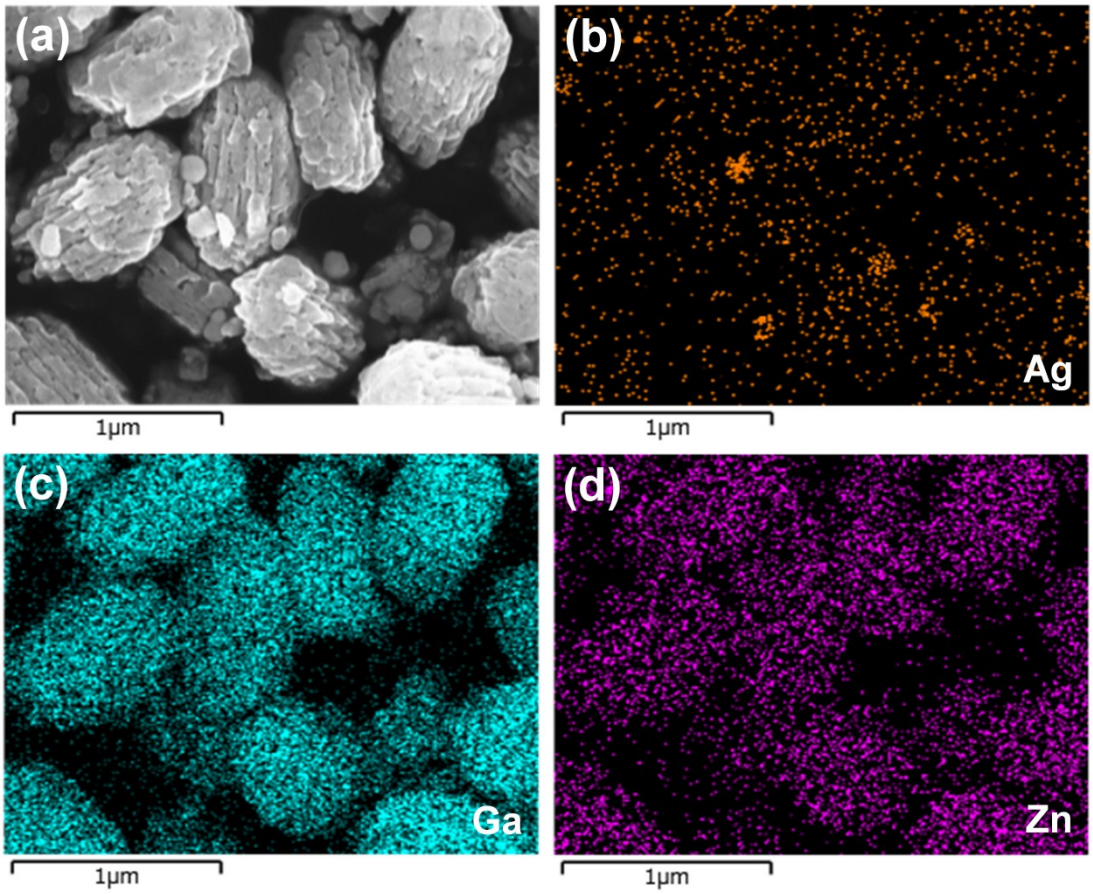

Figure S2 SEM image (a) of Ag(1.0 wt%)-loaded Zn(3.0 mol%)-modified Ga_2O_3 and elemental mapping of Ag (b), Ga (c), and Zn (d) for SEM image

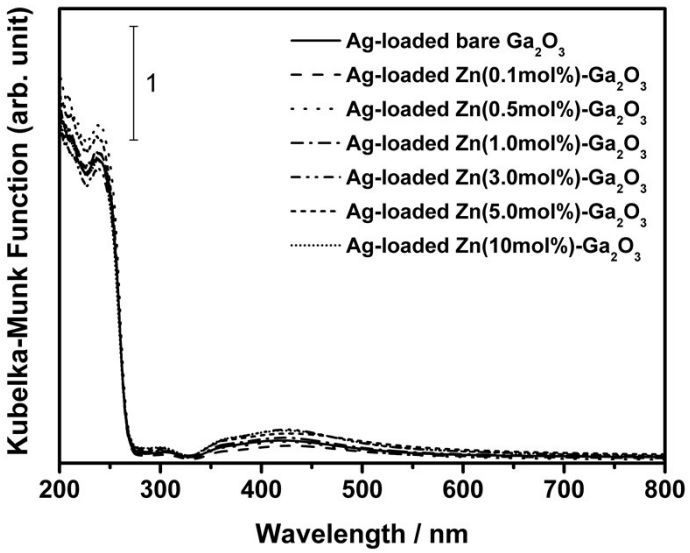

Figure S3 UV-Vis DRS of Ag-loaded Ga_2O_3 and Ag-loaded Zn-modified Ga_2O_3 with various Zn loading amount.

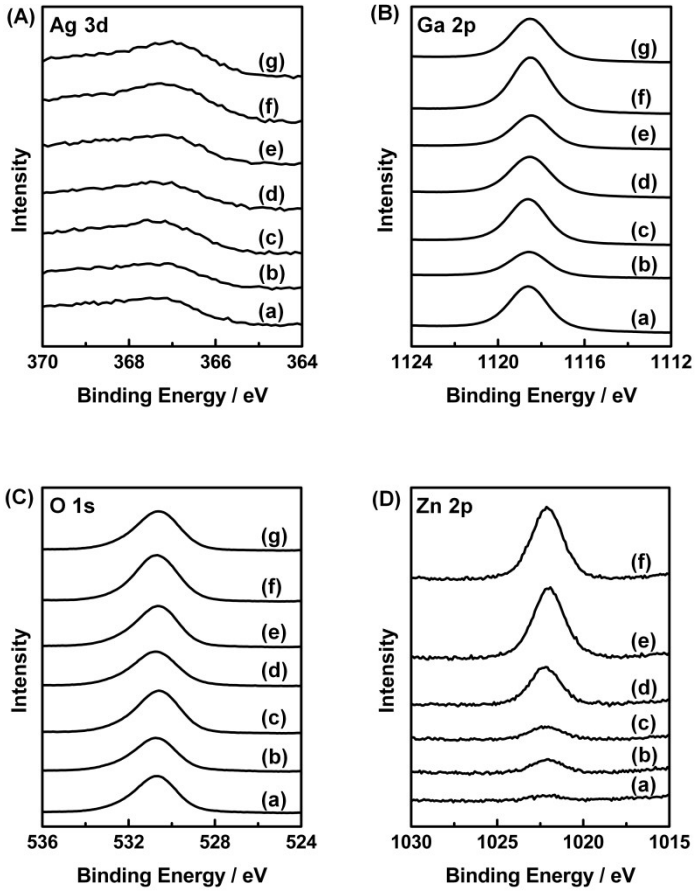

Figure S4 XPS Ag 3d line (A), Ga 2p line (B) and O 1s line (C) for Ag-loaded bare Ga_2O_3 (a) and Ag-loaded Zn-modified Ga_2O_3 with 0.1 mol% (b), 0.5 mol% (c), 1.0 mol% (d), 3.0 mol% (e), 5.0 mol% (f), and 10.0 mol% (g) of Zn species, and Zn 2p line (D) for Ag-loaded Zn-modified Ga_2O_3 with 0.1 mol% (a), 0.5 mol% (b), 1.0 mol% (c), 3.0 mol% (d), 5.0 mol% (e), and 10.0 mol% (f) of Zn species.

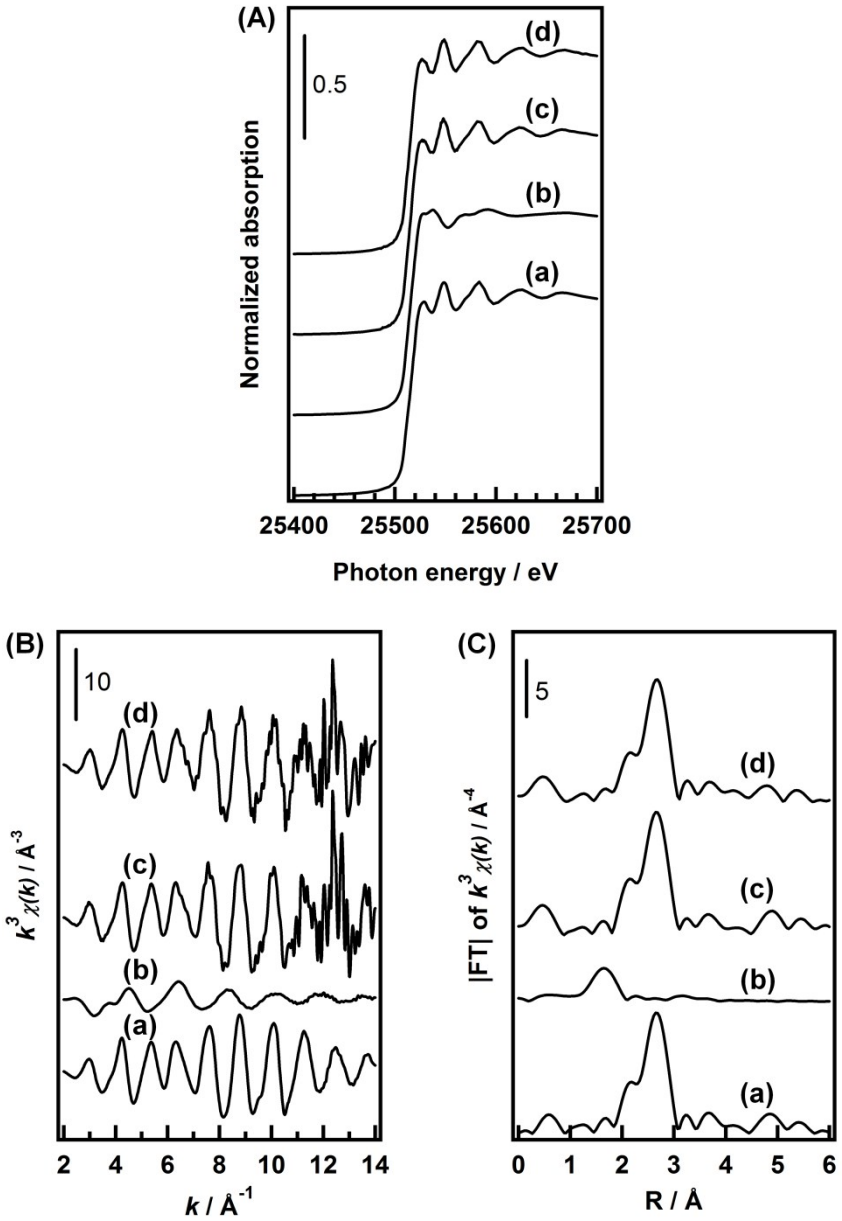

Figure S5 The Ag K-edge XANES (A), EXAFS (B) and Fourier transforms of EXAFS (C) spectra of Ag foil (a), Ag_2O (b), Ag(1.0 wt%)-loaded Ga_2O_3 (c) and Ag(1.0 wt%)-loaded Zn(3.0 mol%)-modified Ga_2O_3 (d).

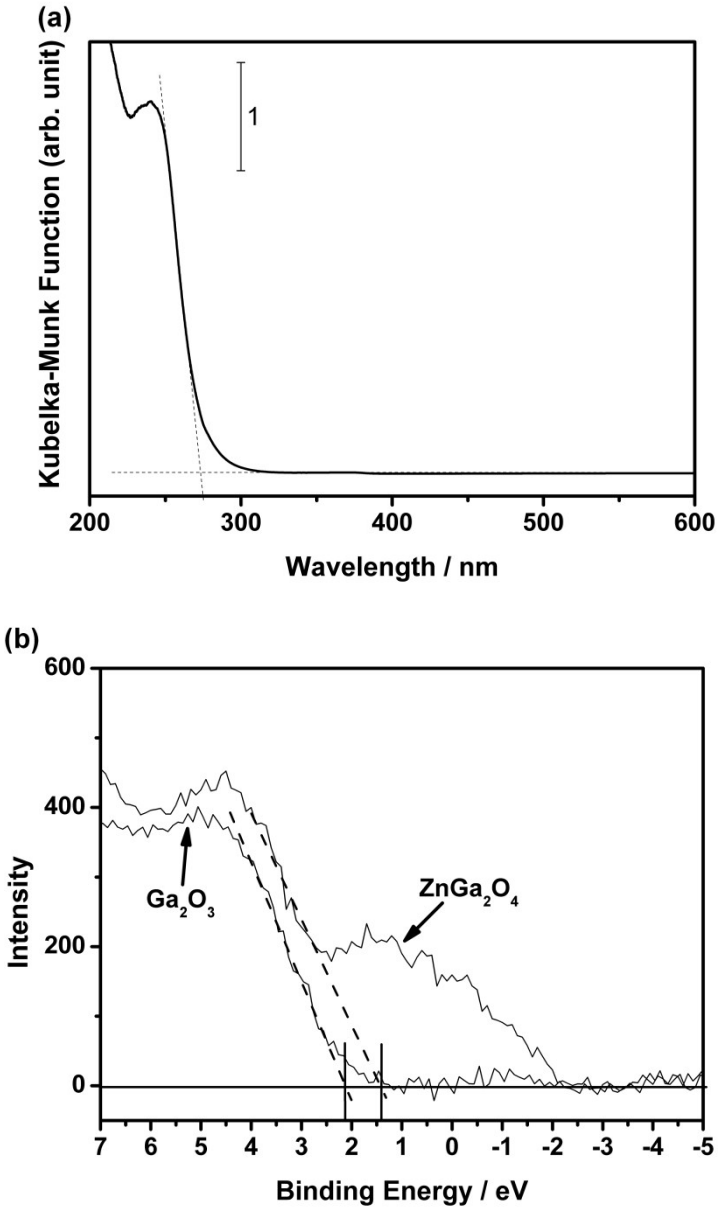

Figure S6 (a) UV-Vis DRS of $ZnGa_2O_4$ and (b) XPS valence band spectra of Ga_2O_3 and $ZnGa_2O_4$. The difference of the valence band between $ZnGa_2O_4$ and Ga_2O_3 is about 0.8 eV.