

Ag co-catalyst prepared by ultrasonic reduction method for efficient photocatalytic conversion of CO₂ with H₂O using ZnTa₂O₆ photocatalyst

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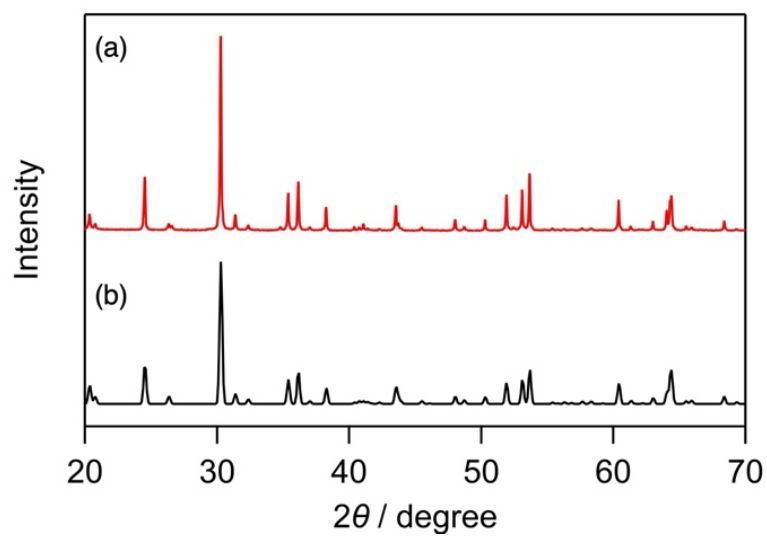


Figure S1 XRD patterns of (a) ZnTa₂O₆ and (b) reference patterns of ZnTa₂O₆ (ICSD #36289).

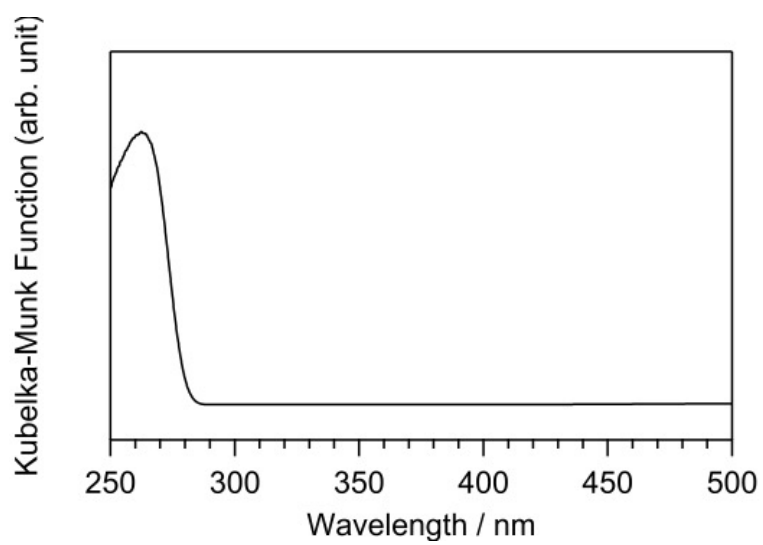


Figure S2 Ultraviolet–visible (UV-vis) diffuse reflectance spectrum of ZnTa_2O_6 .

Table S1 The amount of loaded Ag co-catalyst on ZnTa₂O₆ (Ag/ZnTa₂O₆) fabricated by the four different modification methods (i.e. USR, CR, IMP, and PD). The total amount of loaded Ag species was determined by analyzing solution after dissolving Ag/ZnTa₂O₆ in concentrated nitric acid via inductively coupled plasma optical emission spectrometry (ICP–OES, iCAP 7400 ICP-OES DUO, Thermo Fischer Scientific Inc.).

| Modification method | Calculated amount (wt.%) | Experimental amount (wt.%) |
|-------------------------------|-----------------------------|-------------------------------|
| Ultrasonic reduction (USR) | 0.5 | 0.49 |
| Chemical reduction (CR) | 0.5 | 0.47 |
| Impregnation (IMP) | 0.5 | 0.50 |
| Photodeposition (PD) | 0.5 | 0.46 |

Table S2 The amount of loaded Ag co-catalyst on ZnTa₂O₆ (Ag/ZnTa₂O₆) fabricated by the USR method. The total amount of loaded Ag species was determined by analyzing solution after dissolving Ag/ZnTa₂O₆ in concentrated nitric acid via inductively coupled plasma optical emission spectrometry (ICP–OES, iCAP 7400 ICP-OES DUO, Thermo Fischer Scientific Inc.).

| Calculated amount (wt.%) | Experimental amount (wt.%) |
|--------------------------|----------------------------|
| 0.1 | 0.10 |
| 0.5 | 0.49 |
| 1.0 | 0.96 |
| 2.0 | 2.1 |
| 3.0 | 3.2 |
| 5.0 | 5.1 |

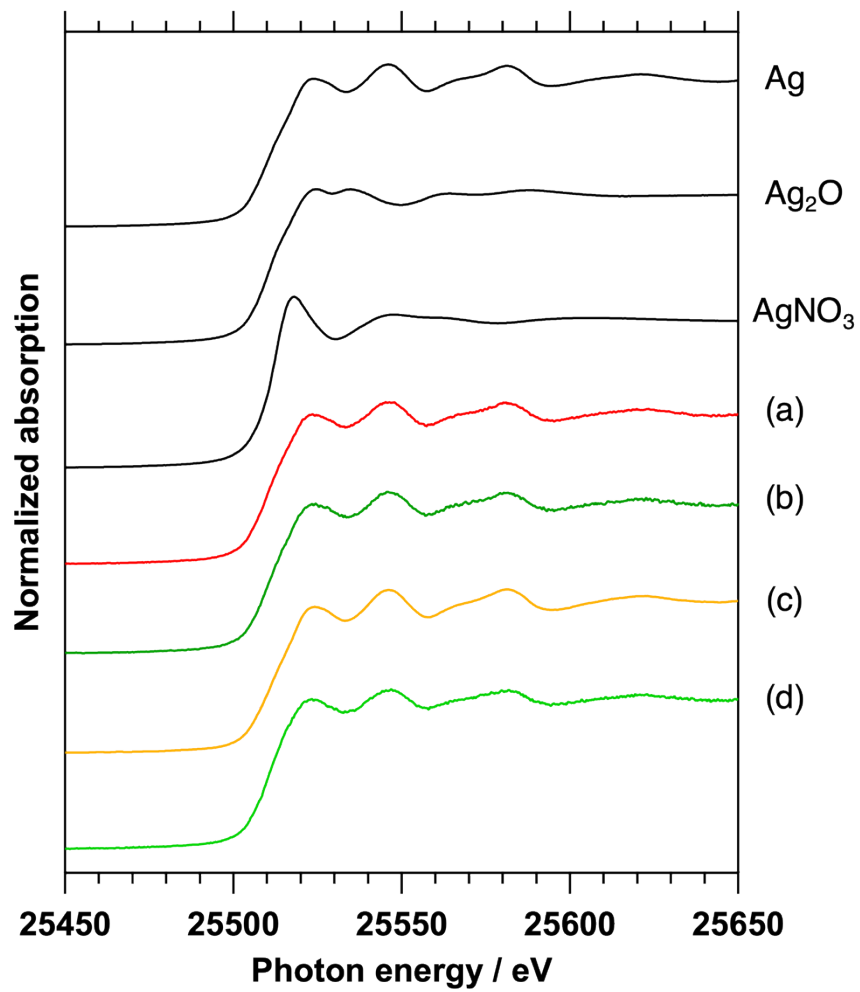


Figure S3 XANES spectra of Ag loaded photocatalysts with references. (a) Ag/Ta₂O₅_USR, (b) Ag/Ta₂O₅_IMP, (c) Ag/Ga₂O₃_USR, and (d) Ag/Ga₂O₃_IMP.

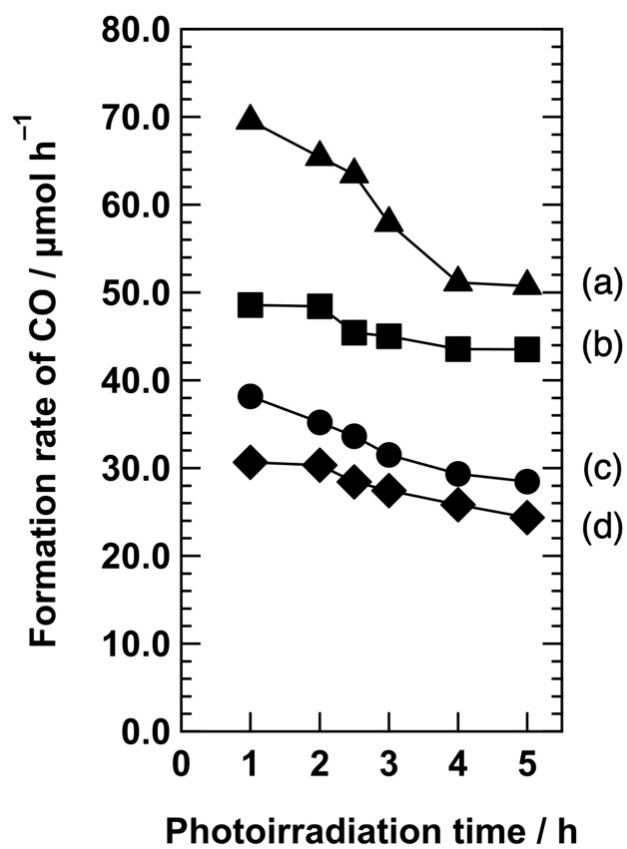


Figure S4 Time courses of formation rates of CO over $\text{Ag}/\text{ZnTa}_2\text{O}_6$ catalysts prepared by (a) an ultrasonic reduction (USR), (b) a chemical reduction (CR), (c) an impregnation (IMP), and (d) a photodeposition (PD) methods.

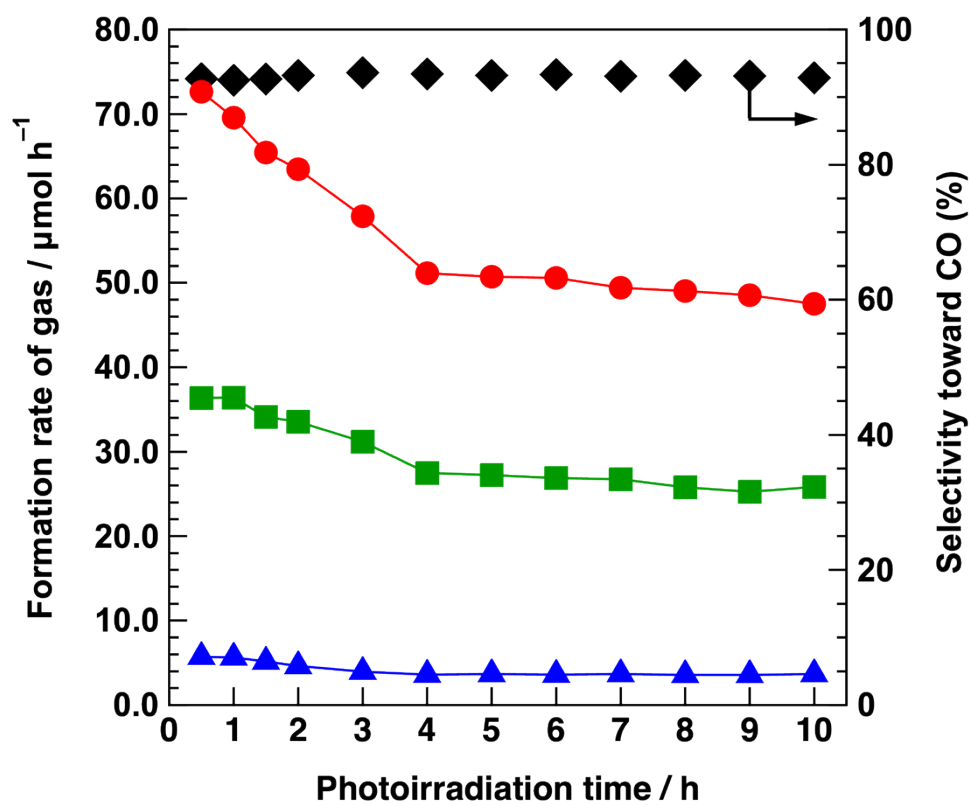


Figure S5 Time courses of formation rates of H_2 (blue), O_2 (green), and CO (red), and selectivity toward CO evolution in the photocatalytic conversion of CO_2 by H_2O over $\text{Ag/ZnTa}_2\text{O}_6$ fabricated by the USR method.

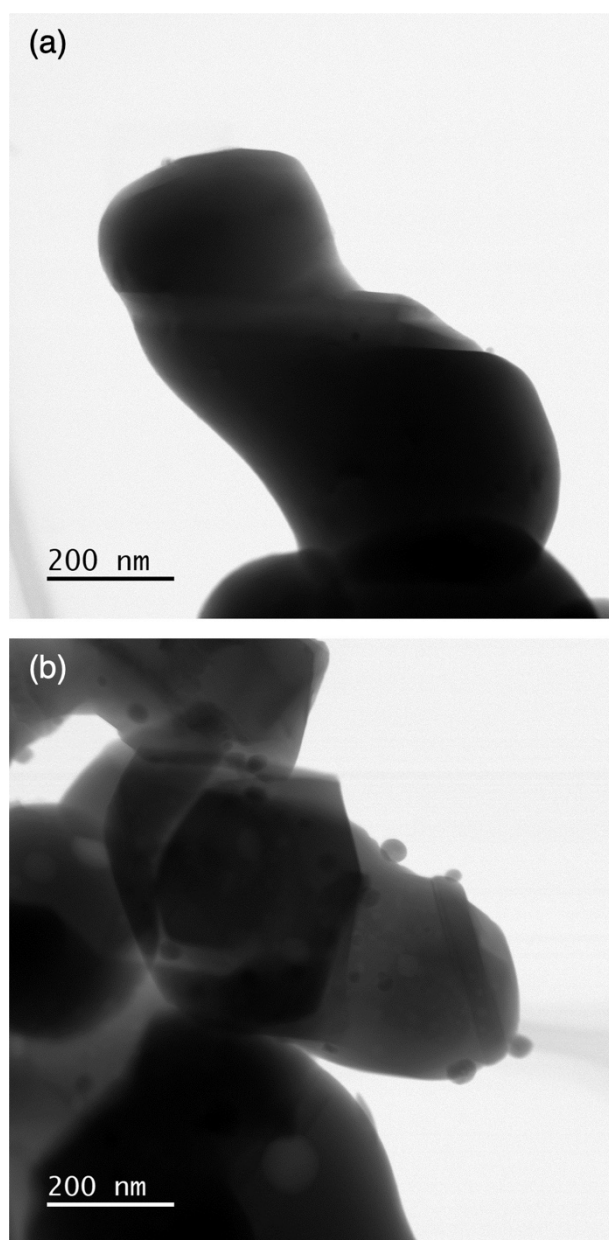


Figure S6 TEM images of Ag/ZnTa₂O₆ modified by the USR method; (a) before and (b) after photocatalytic reaction.

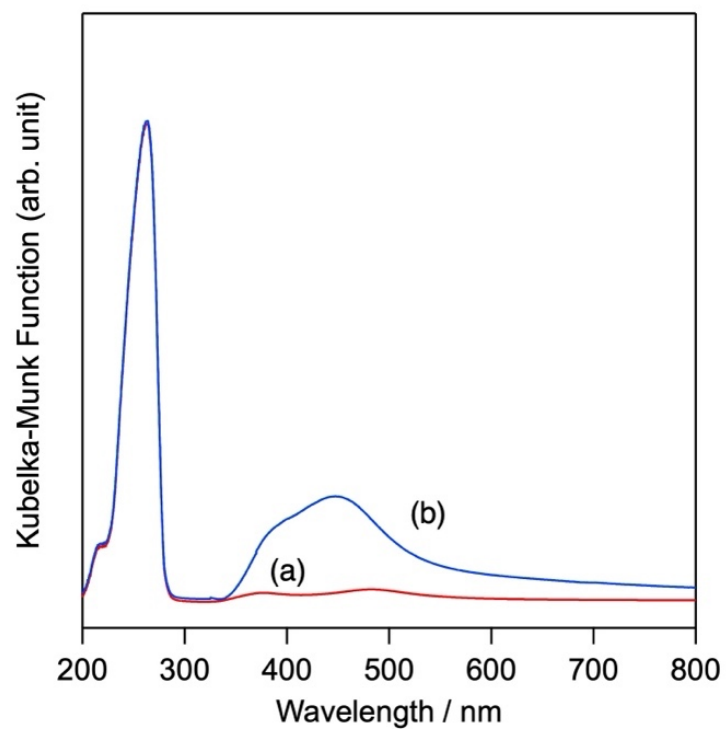


Figure S7 UV-vis diffuse reflectance spectra of Ag/ZnTa₂O₆ modified by the USR method (a) before and (b) after photocatalytic reaction.

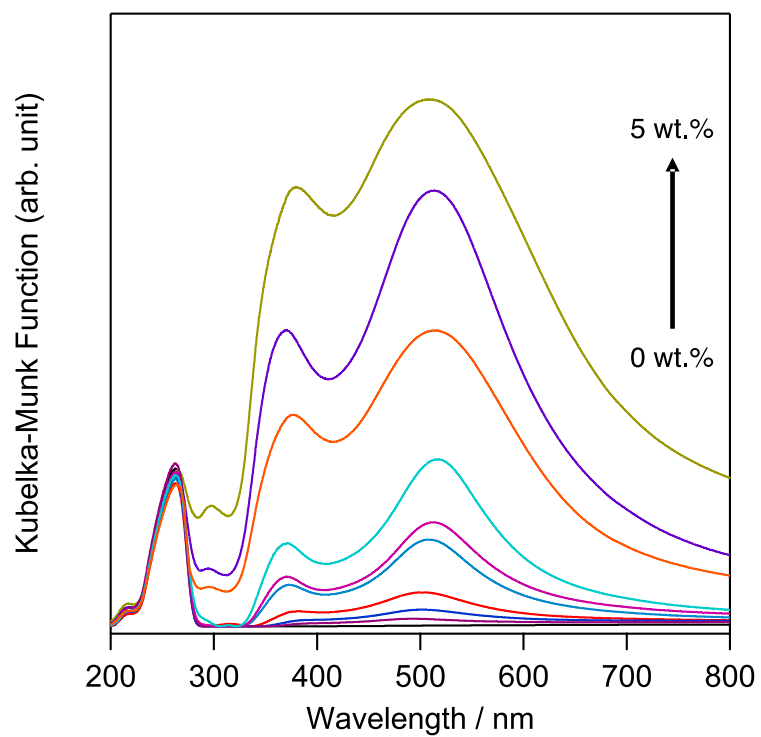


Figure S8 UV-vis diffuse reflectance spectra of Ag/ZnTa₂O₆ with various loading amounts of Ag fabricated by the USR method.

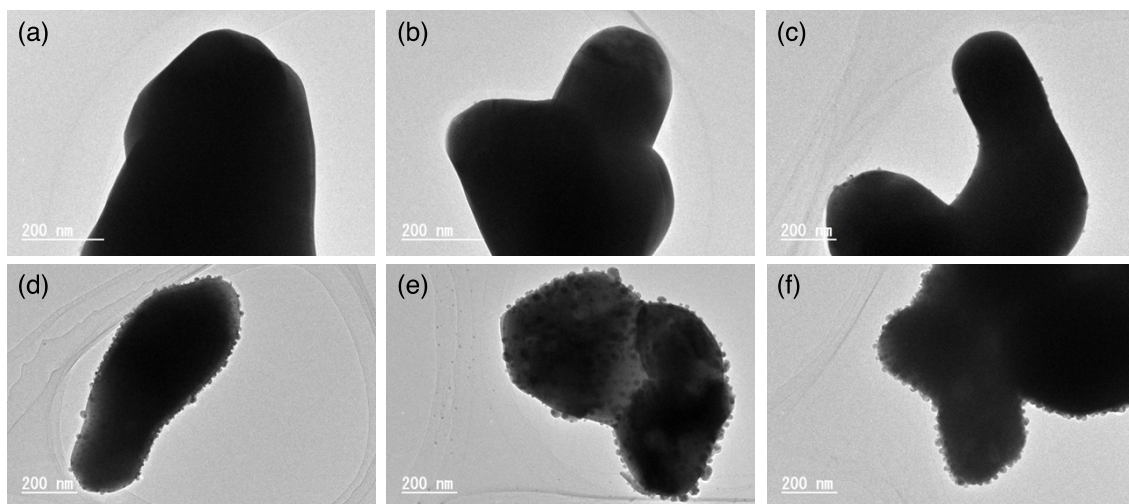


Figure S9 TEM images of Ag/ZnTa₂O₆ with various loading amounts of Ag fabricated by the USR method; (a) 0.1, (b) 0.5, (c) 1.0, (d) 2.0, (e) 3.0, and (f) 5.0 wt.%.

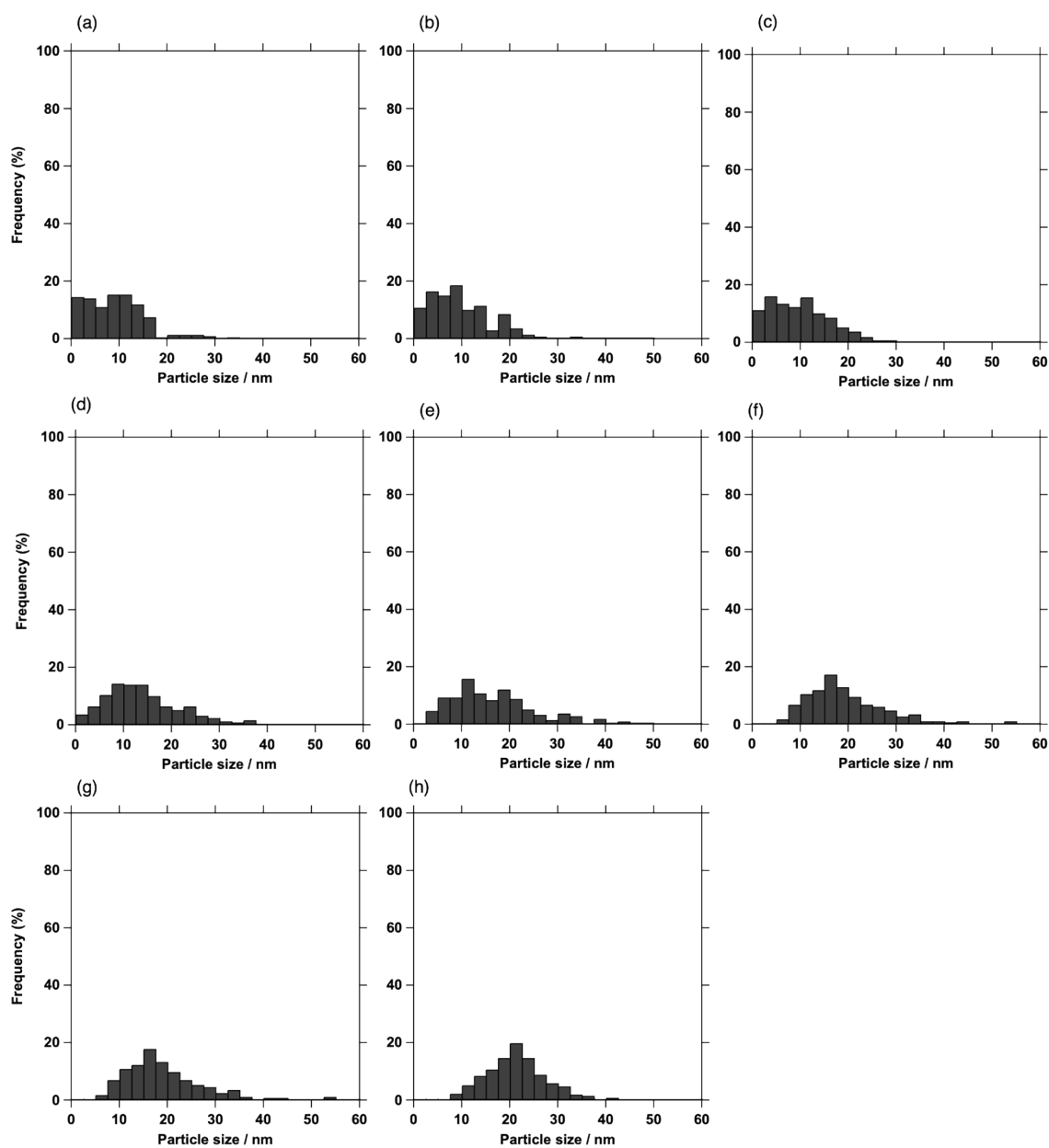


Figure S10 The size distribution of Ag particles on the surface of ZnTa₂O₆ with various loading amounts of Ag fabricated by the USR method; (a) 0.1, (b) 0.25, (c) 0.5, (d) 1.0, (e) 1.5, (f) 2.0, (g) 3.0, and (h) 5.0 wt.%.