

Supporting Information for

**Photocatalytic hydrogen peroxide
production with an external quantum yield
of almost 500%**

Yaozong Yan,^a Shin-ichi Naya,^{b*} Hisashi Sugime,^{a,c} Hiroaki Tada,^{d*}

and Tetsuro Soejima^{a,c*}

^[a] Graduate School of Science and Engineering, Kindai University, 3-4-1, Kowakae, Higashi-Osaka, Osaka 577-8502, Japan.

^[b] Environmental Research Laboratory, Kindai University, 3-4-1, Kowakae, Higashi-Osaka, Osaka 577-8502, Japan.

^[c] Department of Applied Chemistry, Faculty of Science and Engineering, Kindai University, 3-4-1, Kowakae, Higashi-Osaka, Osaka 577-8502, Japan.

^[d] Tokai National Higher Education and Research System, Furo-cho, Chikusa-ku, Nagoya, Aichi 464-8603, Japan.

* To whom correspondence should be addressed: Prof. Hiroaki Tada, Prof. Tetsuro Soejima, or Dr. Shin-ichi Naya

E-mail: htada0409@gmail.com, soejima@apch.kindai.ac.jp, shinichi.naya@itp.kindai.ac.jp

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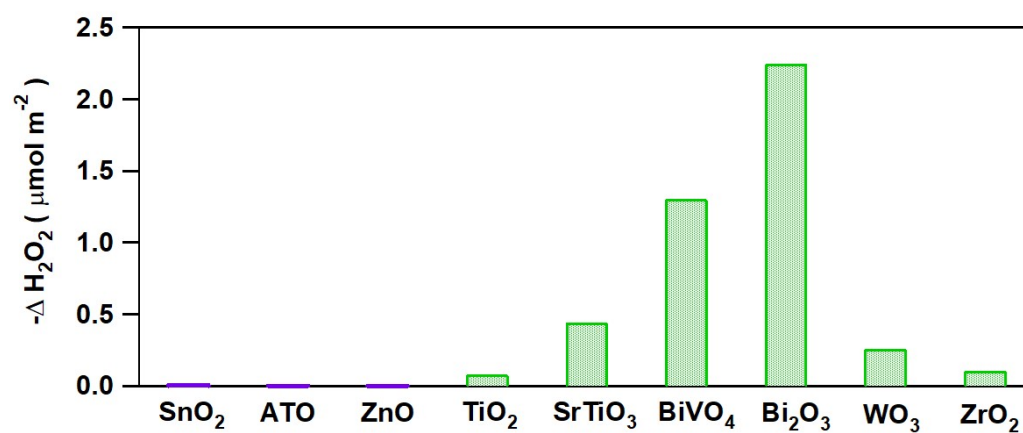


Fig. S1. Reduced amounts of H_2O_2 in the solution (0.1 mM, 10 mL) with various metal oxide particles (100 mg) at 298 K.

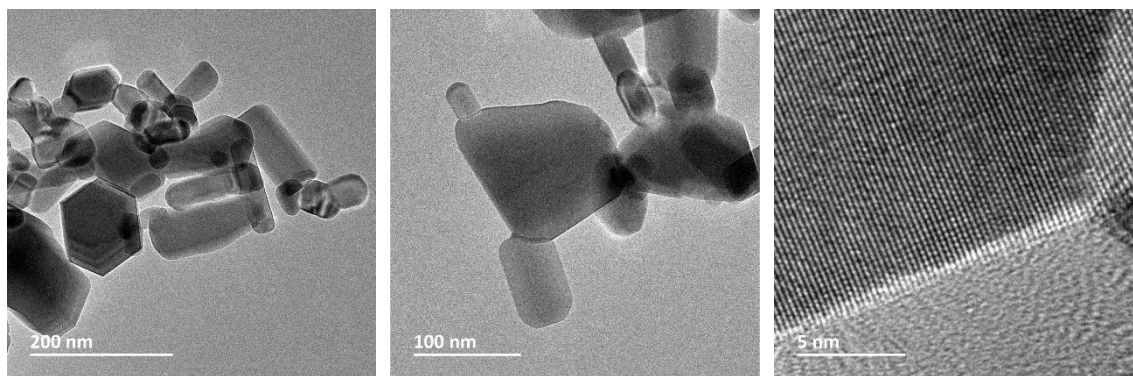


Fig. S2. TEM images of ZnO particles observed at different magnifications.

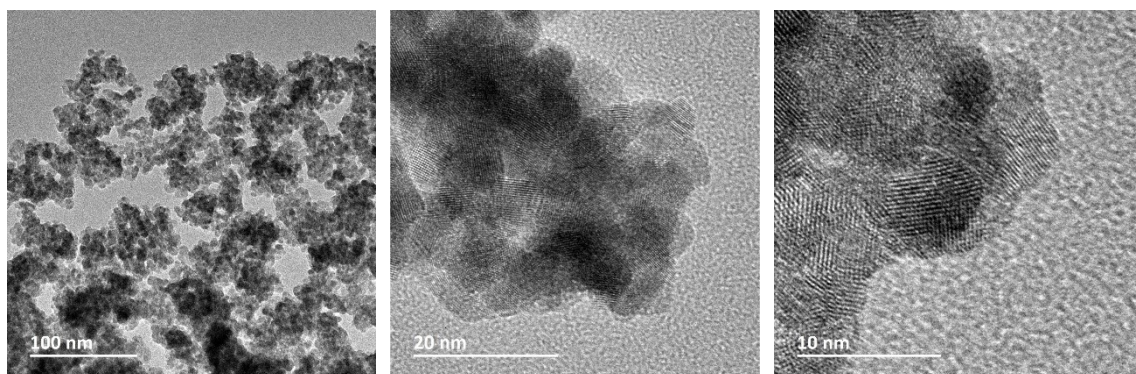


Fig. S3. TEM images of ATO particles observed at different magnifications.

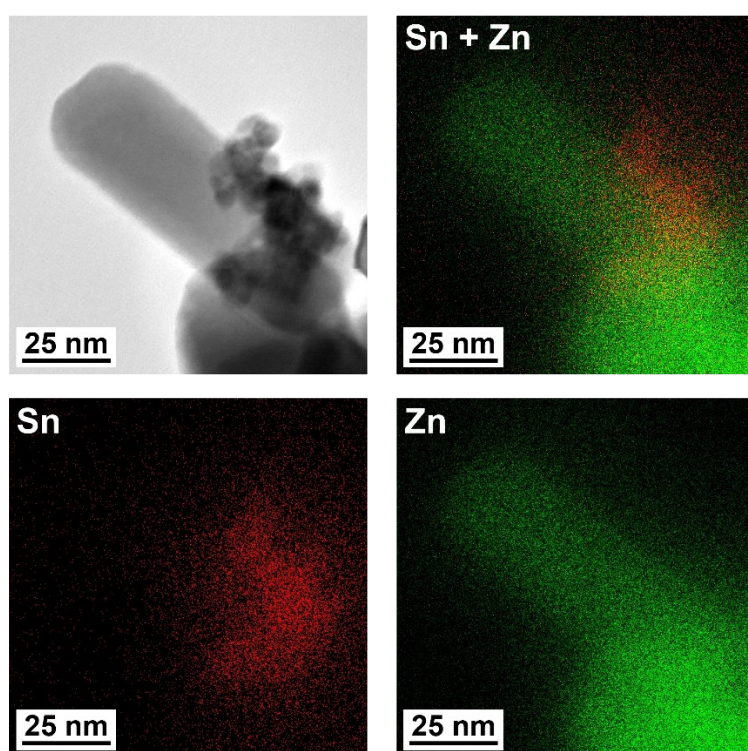


Fig. S4. TEM-EDS analysis for ht-ATO-CL/ZnO particles.

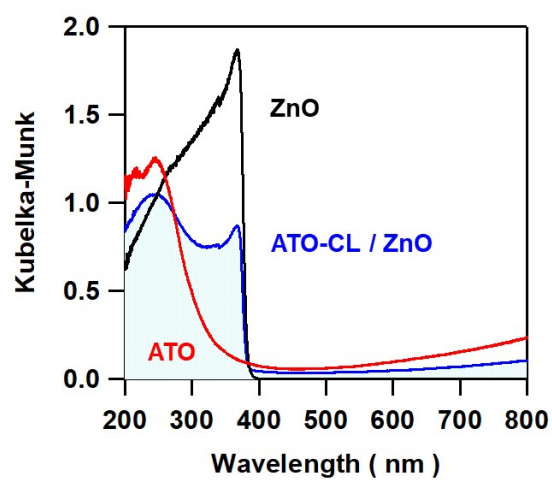


Fig. S5. Kubelka-Munk-transformed UV-Vis-NIR absorption spectra of ZnO, ATO, and ATO-CL(100)/ZnO(50).

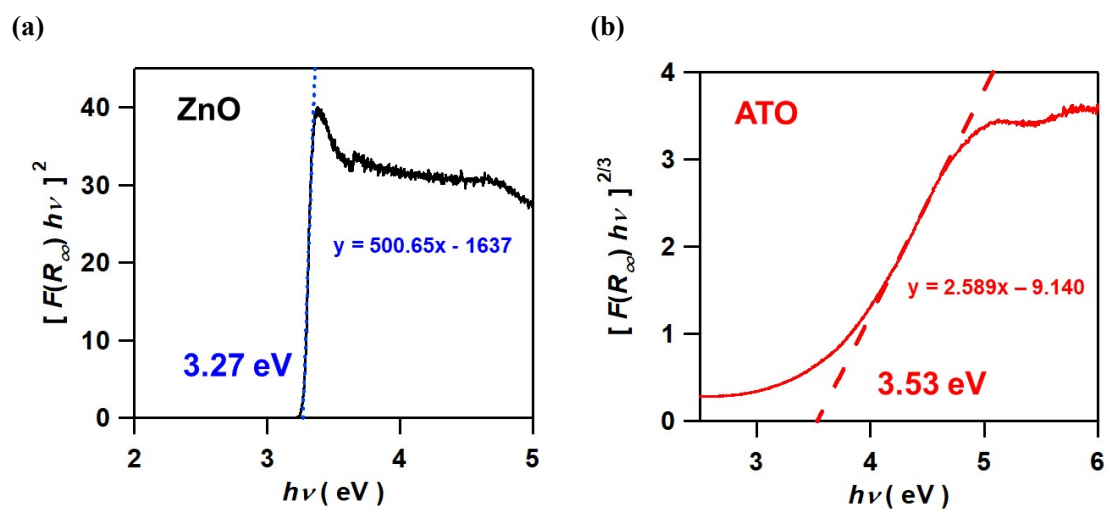


Fig. S6. Tauc plots of ZnO (a) and ATO (b).

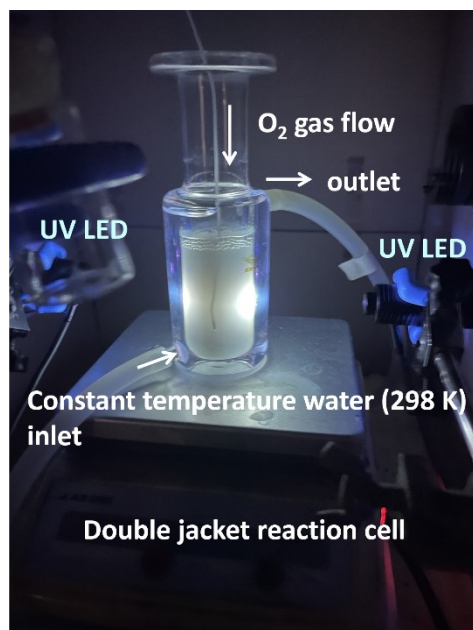


Fig. S7. Photo of the reactor used for photocatalytic H₂O₂ production.

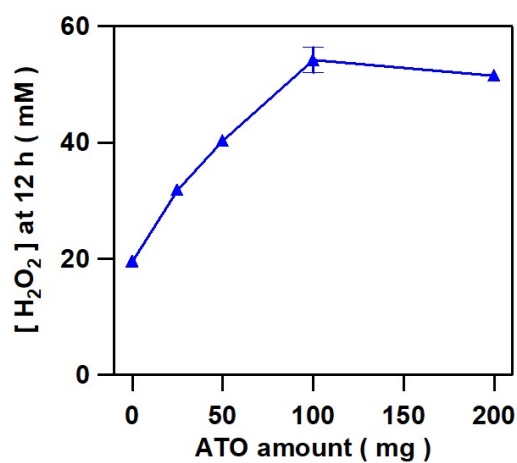


Fig. S8. Plots of the H₂O₂ concentration generated after 12 h irradiation vs. ATO content. The values in the abscissa show the x values with the y value fixed at 50 mg.

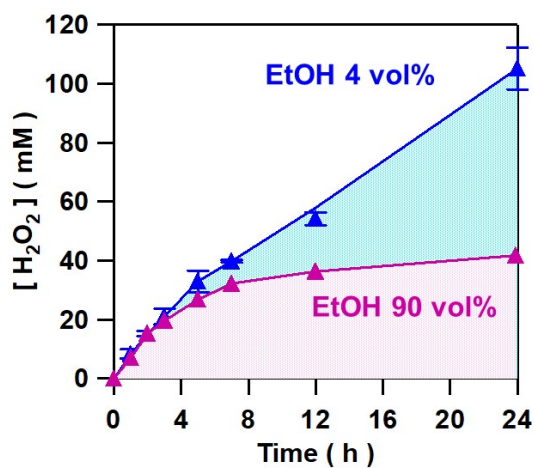


Fig. S9. Time courses for H₂O₂ generation from 4 vol% and 90 vol% ethanol aqueous solutions (pH 6.4, 50 mL) in the ATO-CL(100)/ZnO(50) system under UV-light irradiation ($\lambda = 365$ nm) using two LED lamps (each light intensity = 120 mW cm⁻²).

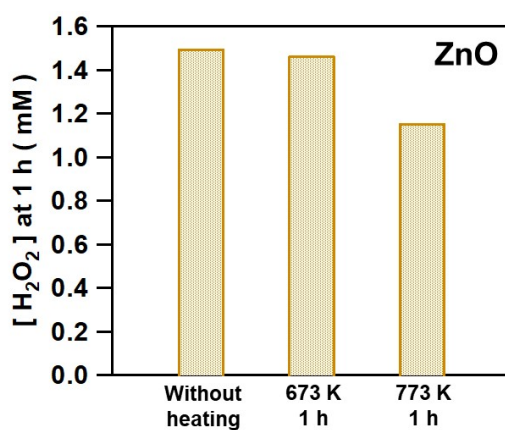


Fig. S10. Concentration of H₂O₂ generated after 1 h from an O₂-saturated 4 vol% EtOH solution (50 mL) with ZnO particles (50 mg) under UV-light irradiation ($\lambda = 365$ nm) using two LED lamps (each light intensity = 120 mW cm⁻²).

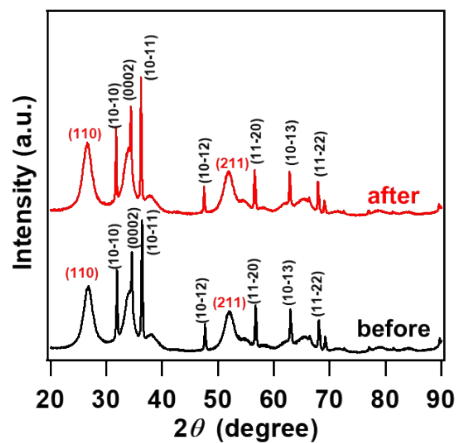


Fig. S11. XRD patterns of ht-ATO-CL(100)/ZnO₂(50) before and after 24 h reaction under UV-light irradiation ($\lambda = 365$ nm) using two LED lamps (each light intensity = 120 mW cm⁻²).

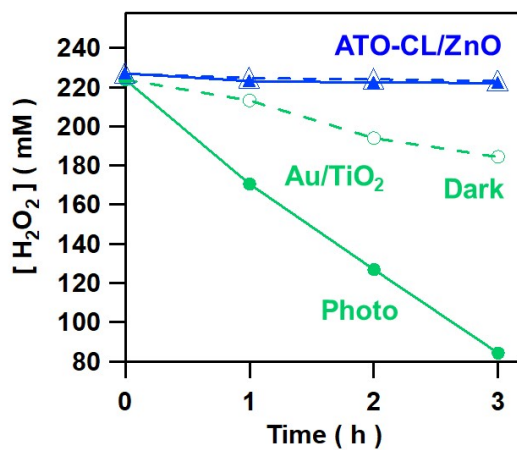


Fig. S12. Time courses for the H₂O₂ concentration in the presence of Au/TiO₂ and ATO-CL(100)/ZnO₂(50) in dark and under UV-light irradiation ($\lambda = 365$ nm) using two LED lamps (each light intensity = 120 mW cm⁻²).

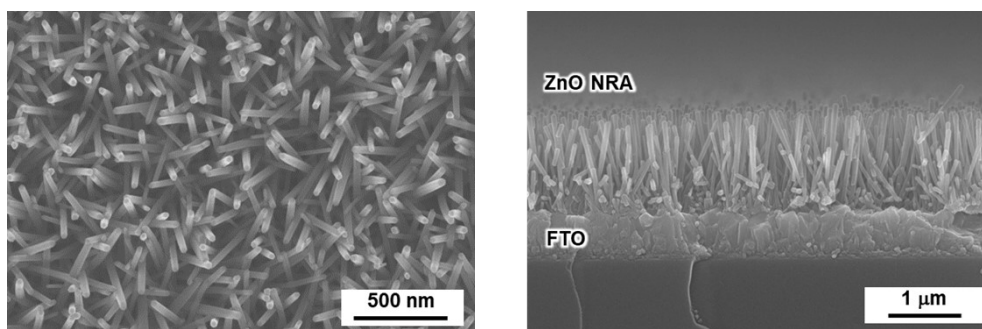


Fig. S13. SEM images of ZnO nanorod array electrode.

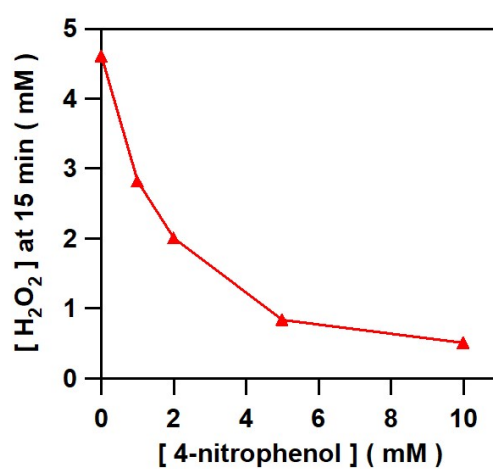


Fig. S14. Additive effect of 4-nitrophenol on the ATO-CL/ZnO-photocatalyzed H₂O₂ production under UV-light irradiation ($\lambda = 365$ nm, light intensity = 120 mW cm^{-2}). Photoirradiation time was fixed at 15 min.