Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information:

Synthesis, Structure and Photocatalytic Activity of Layered $LaOInS_2$

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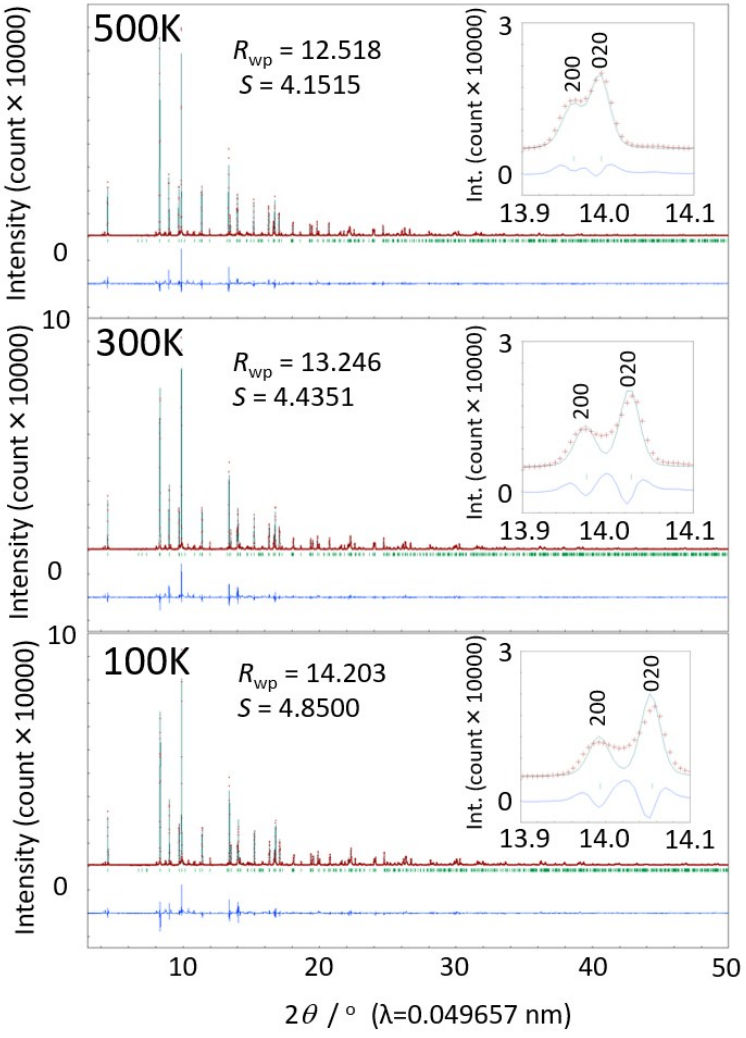

Figure S1 Rietveld refinement profile of $LaOInS_2$ at 100, 300 and 500 K.

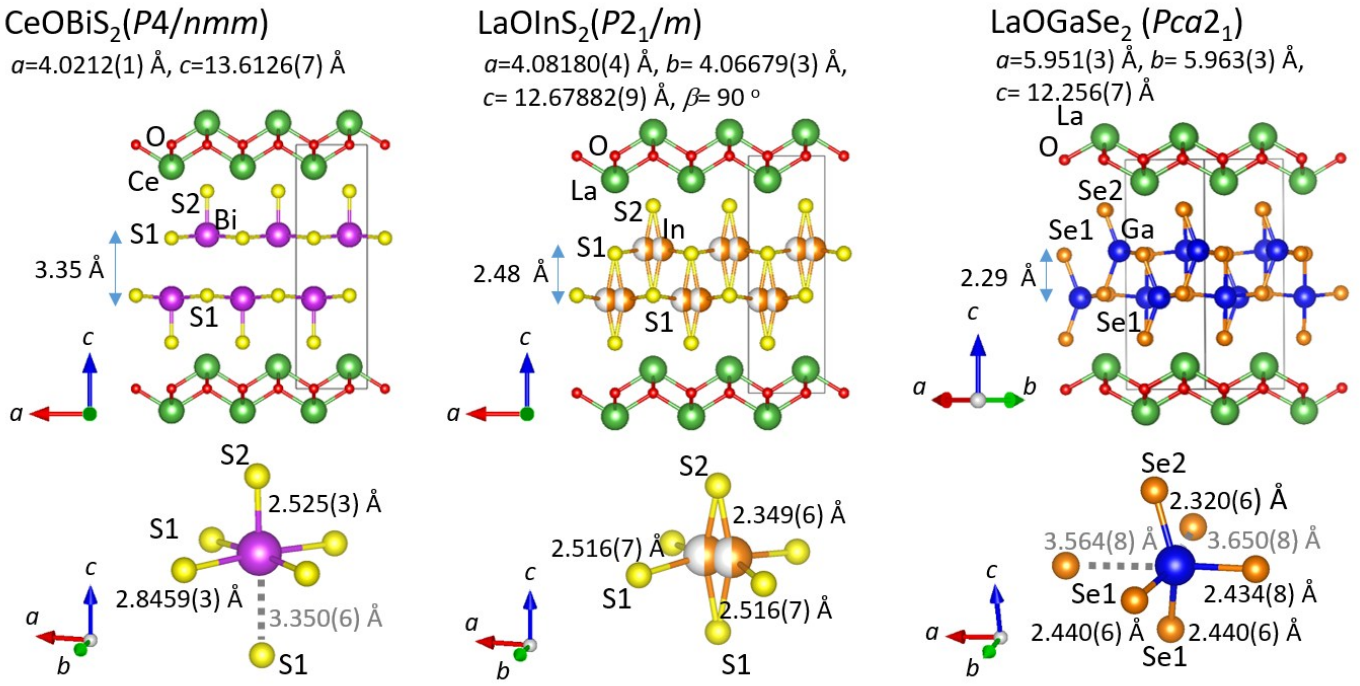

Figure S2 Crystal structure of structurally related layered oxychalcogenides: $CeOBiS_2$[1], $LaOInS_2$(this work) and $LaOGaSe_2$[2]. Grey lines indicate the unit cell.

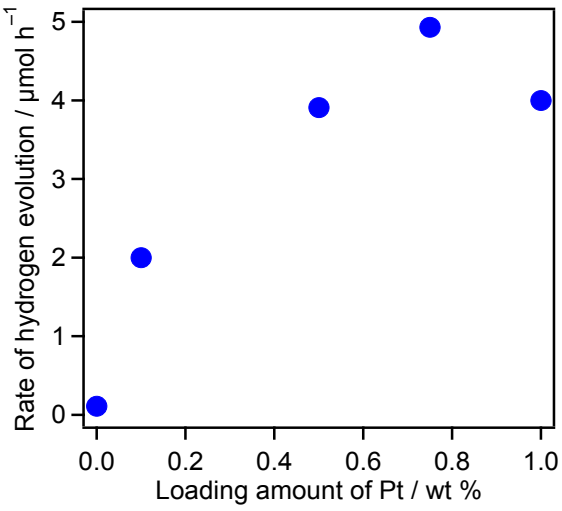

Figure S3 Dependence of photocatalytic H_2 evolution activity of Pt/$LaOInS_2$ on the loading amount of Pt under visible light ($420 < \lambda < 800$ nm). Reaction conditions: catalyst, 50 mg; aqueous methanol solution (10 vol%, 140 mL); light source, xenon lamp (300 W) with cutoff filter; reaction vessel, Pyrex top-irradiation type.

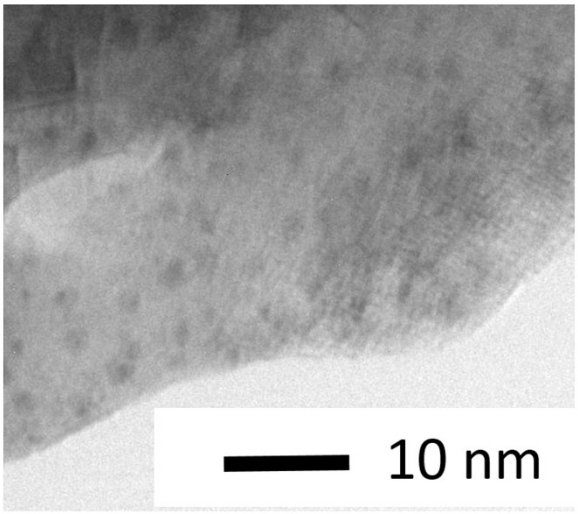

Fig S4 TEM image of 0.75 wt % Pt-loaded $LaOInS_2$.

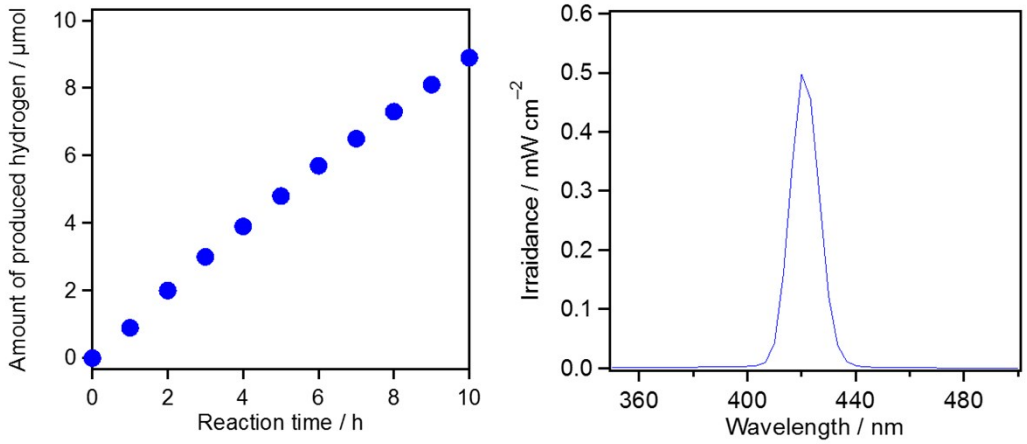

Figure S5 Time course of H_2 evolution on 0.75 wt% Pt/$LaOInS_2$ under visible light irradiation (λ = 420 nm, 8.7 mW). Reaction conditions: catalyst, 50 mg; reactant solution, aqueous methanol solution, 140 mL (10 vol.%); light source, xenon lamp (300 W). (Right) Spectral irradiance from the light source.

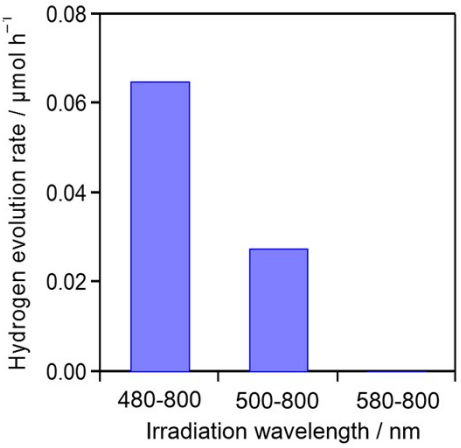

Figure S6 Dependence of the rate of H_2 evolution from Pt/$LaOInS_2$ on different ranges of irradiation wavelength by changing cutoff wavelength of an incident light.

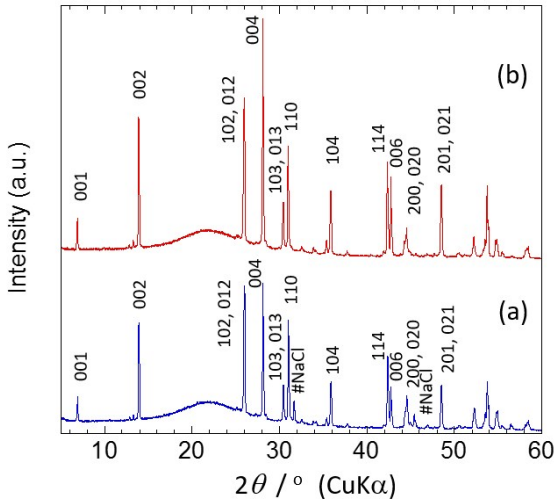

Figure S7 XRD diffraction patterns (a) before and (b) after photocatalytic H_2 evolution.

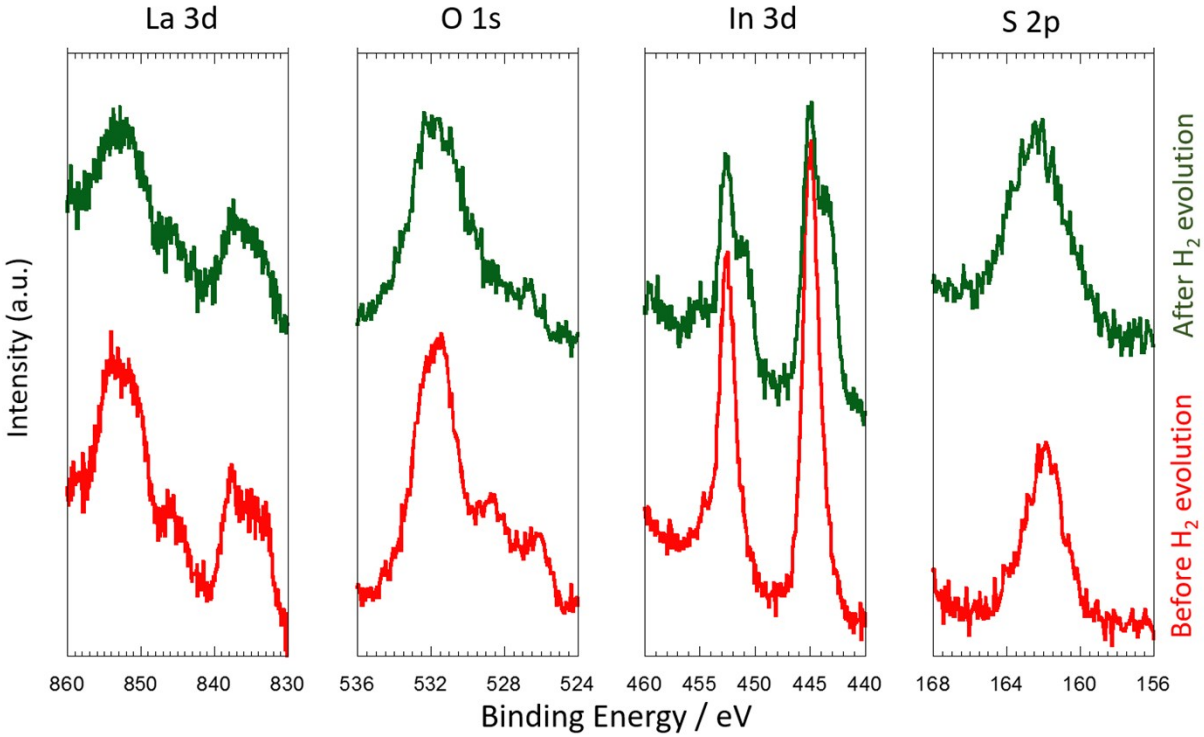

Figure S8 XPS spectra of $LaOInS_2$ (a) before and (b) after photocatalytic H_2 evolution.

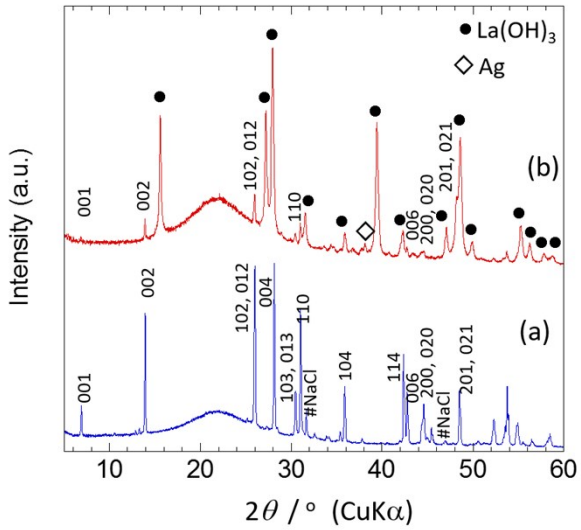

Figure S9 XRD diffraction patterns (a) before and (b) after photocatalytic O_2 evolution.

References

1. Sagayama, R.; Sagayama, H.; Kumai, R.; Murakami, Y.; Asano, T.; Kajitani, J.; Higashinaka, R.; Matsuda, T. D.; Aoki, Y., Symmetry Lowering in LaOBiS2: A Mother Material for BiS2-Based Layered Superconductors. *J. Phys. Soc. Jpn.* **2015,** *84* (12), 123703.

2. Benazeth, S.; Guittard, M.; Laruelle, P., Structure de l'oxyseleniure de lanthane et de gallium, (LaO)GaSe2. *Acta Crystallographica Section C* **1984,** *40* (3), 345-347.