Electronic Supplementary Information

Enhancement of the H_2 evolution activity of $La_5Ti_2Cu(S_{1-x}Se_x)_5O_7$ photocatalysts by coloading Pt and NiS cocatalysts

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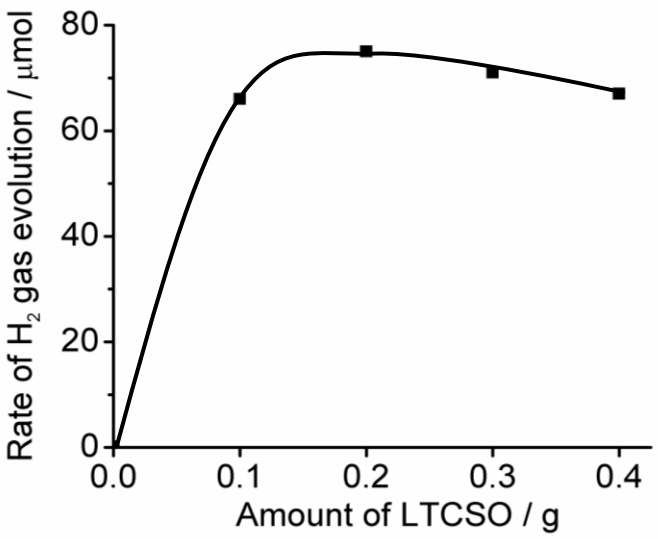

Figure S1. The H_2 evolution rate of LTCSO modified with 1 wt% NiS as a function of the amount of LTCSO. Reaction conditions: 0–0.4 g of LTCSO loaded with 1 wt% NiS, 150 mL of an aqueous 10 mM Na_2S and 10 mM Na_2SO_3 solution, visible light top irradiation with a 300 W Xe lamp through a cut-off filter (λ > 420 nm).

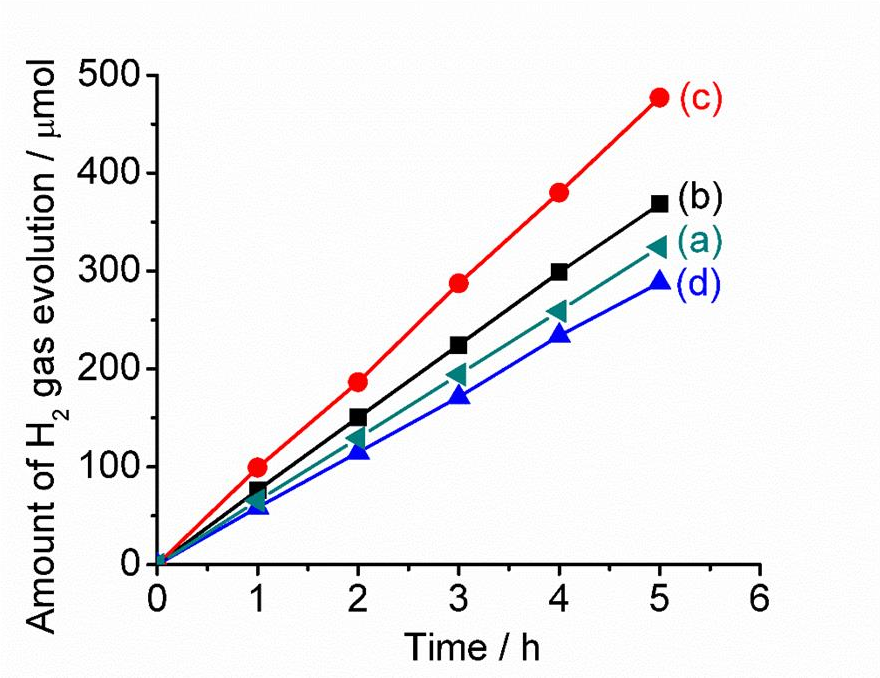

Figure S2. Time courses for H_2 evolution over LTCSO loaded with (a) 1.0, (b) 1.5, (c) 2.0 and (d) 2.5 wt% Pt-pd. Reaction conditions: 0.2 g LTCSO loaded with varying amounts of Pt-pd, 150 mL of an aqueous 10 mM Na_2S and 10 mM Na_2SO_3 solution, visible light top irradiation with a 300 W Xe lamp through a cut-off filter (λ > 420 nm).

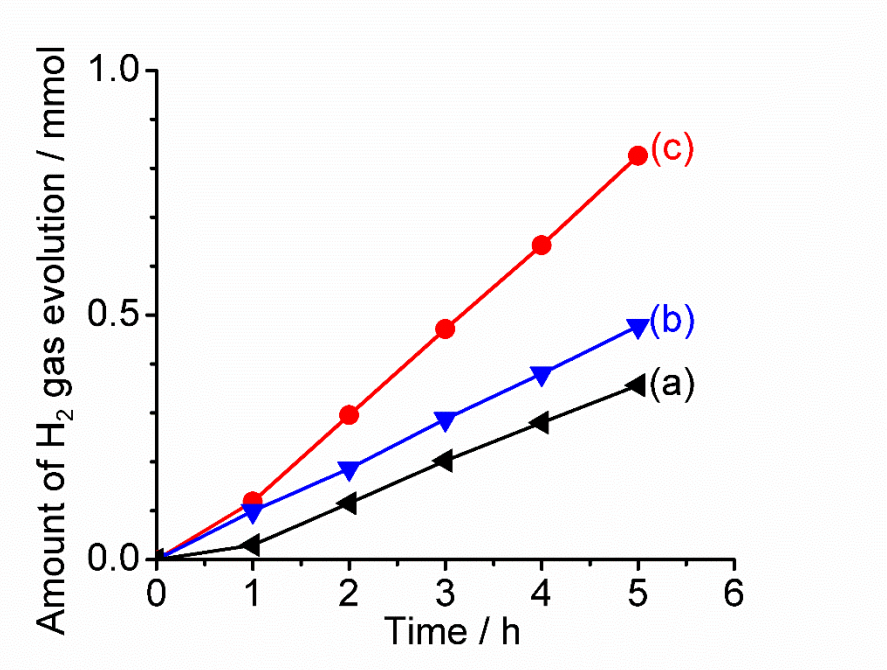

Figure S3. Time courses for H_2 evolution over LTCSO loaded with (a) 1.0 wt% NiS, (b) 2.0 wt% Pt-pd, (c) 2.0 wt% Pt-pd and 1.0 wt% NiS. Reaction conditions: 0.2 g LTCSO loaded with various cocatalysts, 150 mL of an aqueous 10 mM Na_2S and 10 mM Na_2SO_3 solution, visible light top irradiation with a 300 W Xe lamp through a cut-off filter (λ > 420 nm).

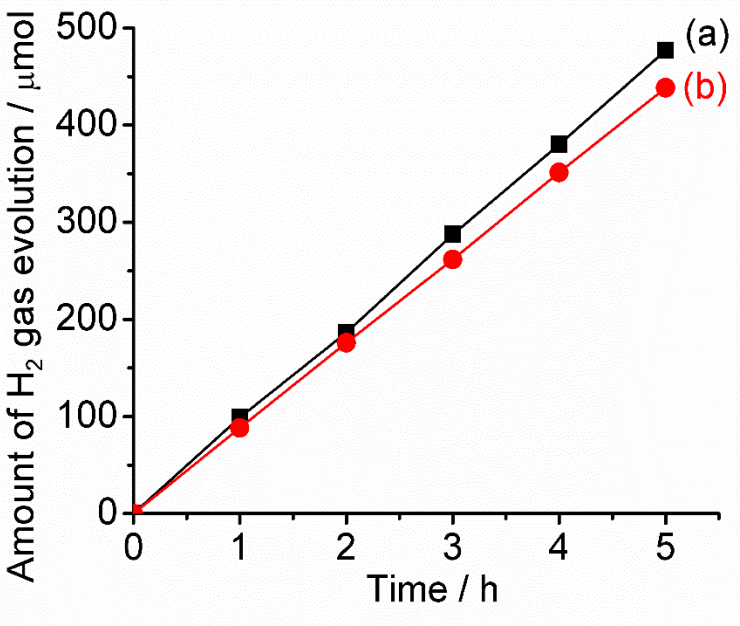

Figure S4. Time courses for H_2 evolution over LTCSO loaded with (a) 2.0 wt% Pt-pd and (b) 1.0 wt% NiS followed by 2.0 wt% Pt-pd. Reaction conditions: 0.2 g LTCSO loaded with various cocatalysts, 150 mL of an aqueous 10 mM Na_2S and10 mM Na_2SO_3 solution, visible light top irradiation with a 300 W Xe lamp through a cut-off filter (λ > 420 nm).

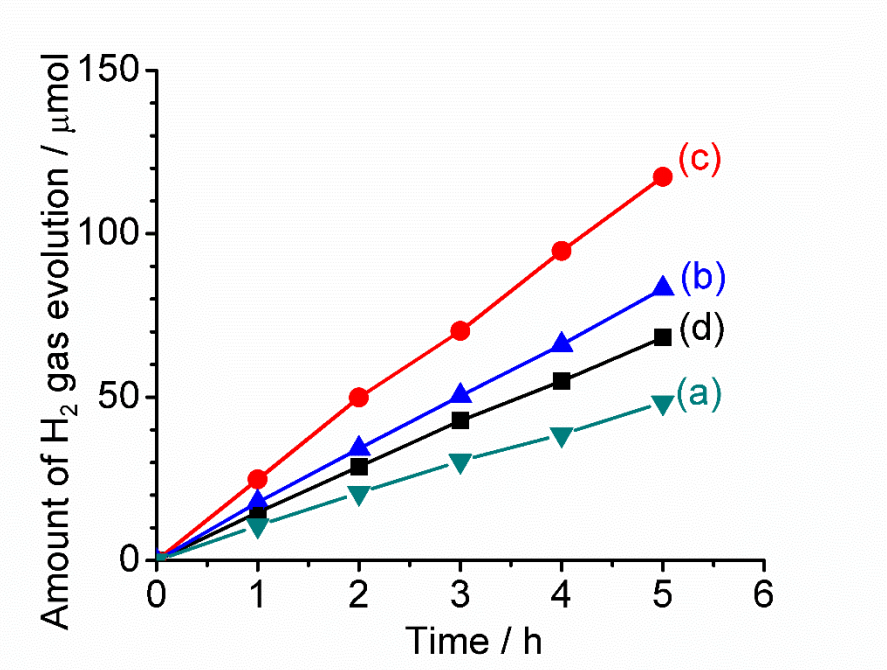

Figure S5. Time courses for H_2 evolution over $LTCS_{0.8}Se_{0.2}O$ loaded with (a) 1.0 (b) 1.5, (c) 2.0, and (d) 2.5 wt% Pt-pd.Reaction conditions: 0.2 g $LTCS_{0.8}Se_{0.2}O$loaded with varying amounts of Pt-pd, 150 mL of an aqueous 10 mM Na_2S and 10 mM Na_2SO_3 solution, visible light top irradiation with a 300 W Xe lamp through a cut-off filter (λ > 420 nm).

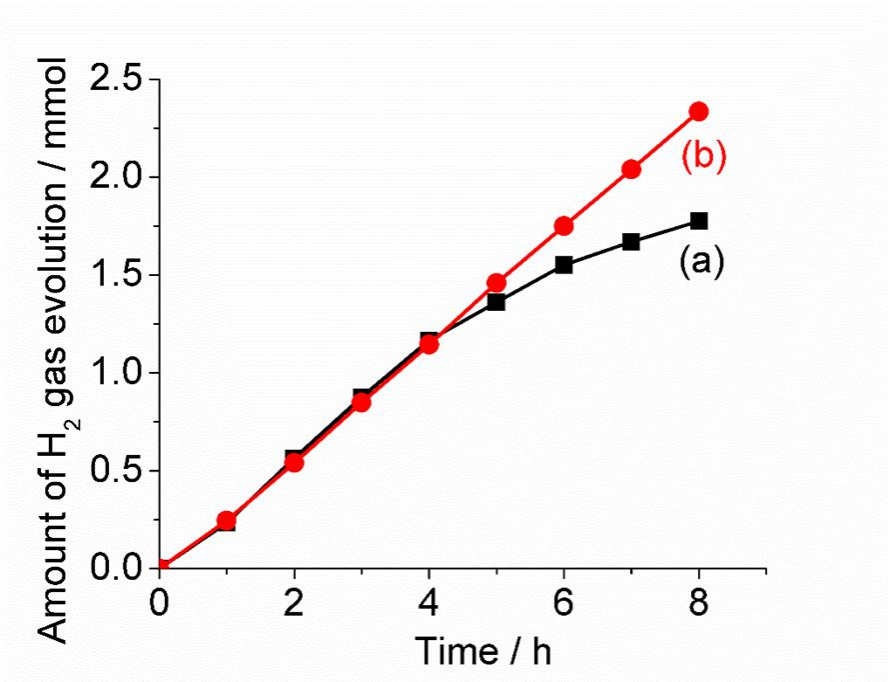

Figure S6. Time courses forH_2 evolution over LTCSO coloaded with 0.3 wt% Pt-imp and 1.0 wt% NiS in aqueous solutions containing (a) 10, and (b) 70mM each of Na_2S and Na_2SO_3. Reaction conditions: 0.2 g $LTCS_{1-x}Se_xO$ loaded with various cocatalysts, 150 mL of an aqueous Na_2S and Na_2SO_3 solution, top irradiation with a 300 W Xe lamp through a cut-off filter (λ > 420 nm).

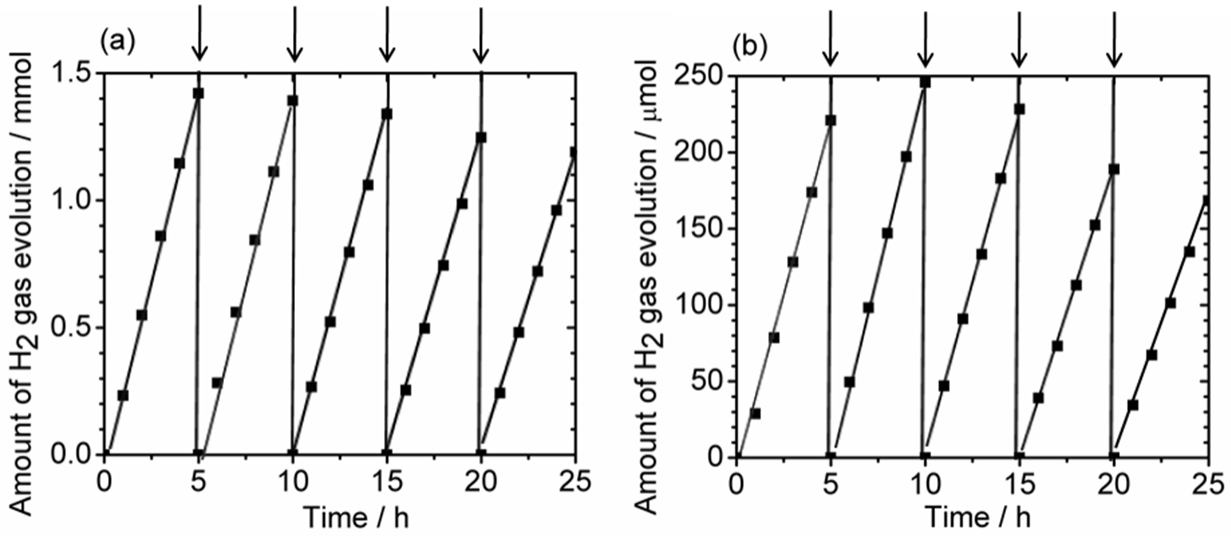

Figure S7. Long-term H_2 evolution reaction data using (a) LTCSO coloaded with 0.3 wt% Pt-imp and 1.0wt% NiS, and (b) $LTCS_{0.8}Se_{0.2}O$ modified with 2.0 wt% Pt-pd and 0.5 wt% NiS. Reaction conditions: 0.2 g $LTCS_{1-x}Se_xO$ loaded with cocatalysts, 150 mL of an aqueous 70 mM Na_2S and70 mM Na_2SO_3 solution, visible light top irradiation with a 300 W Xe lamp through a cut-off filter (λ > 420 nm). The arrows indicate the points at which the apparatus was evacuated.

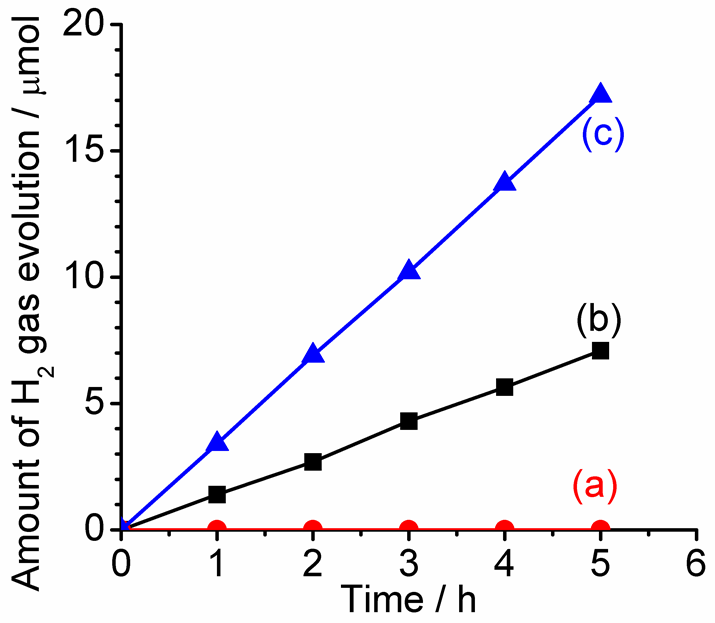

Figure S8. Time courses for H_2 evolution over (a) LTCSO loaded with 0.3 wt% Pt-imp and 1.0 wt% NiS, and (b,c) $LTCS_{0.8}Se_{0.2}O$ loaded with (b) 0.5 wt% NiS and (c) 2.0 wt% Pt-pd and 0.5 wt% NiS under red light irradiation (λ = 680 ± 30 nm). Reaction conditions: 0.2 g $LTCS_{1-x}Se_xO$ loaded with various cocatalysts, 150 mL of an aqueous 10 mM Na_2S and 10 mM Na_2SO_3 solution, top irradiation with a 300 W Xe lamp through a band-pass filter (λ = 680 ± 30 nm).

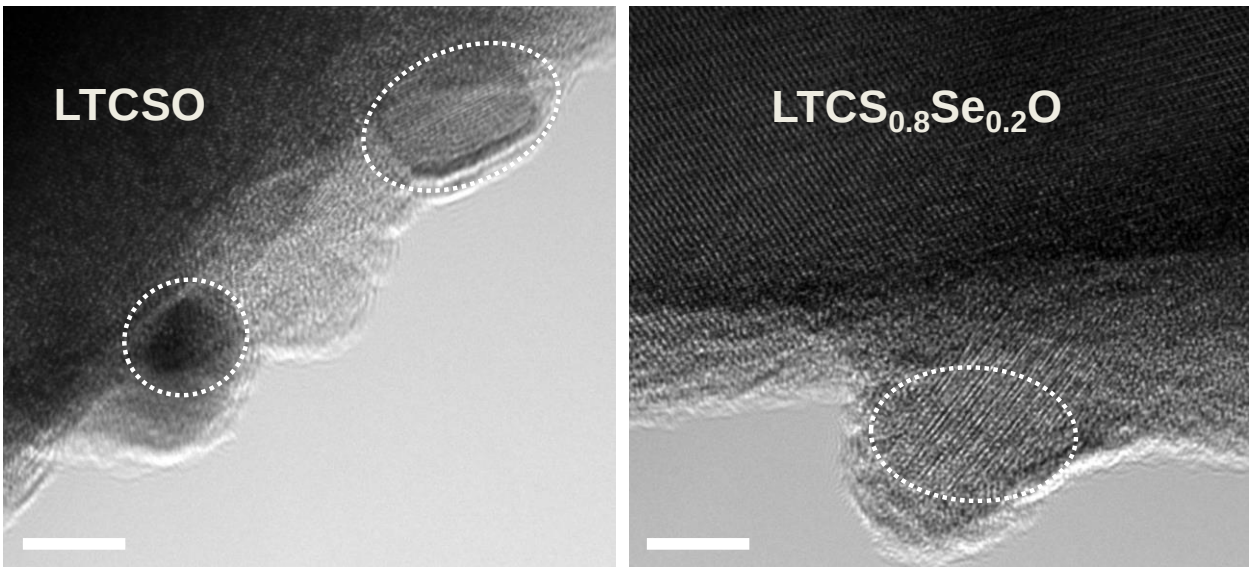

Figure S9. HR-TEM images of LTCSO and $LTCS_{0.8}Se_{0.2}O$ coloaded with Pt and NiS after a photocatalytic reaction under visible light irradiation (λ > 420 nm). The white ellipses indicate partly crystalline Pt nanoparticles. The scale bars represent 5 nm.

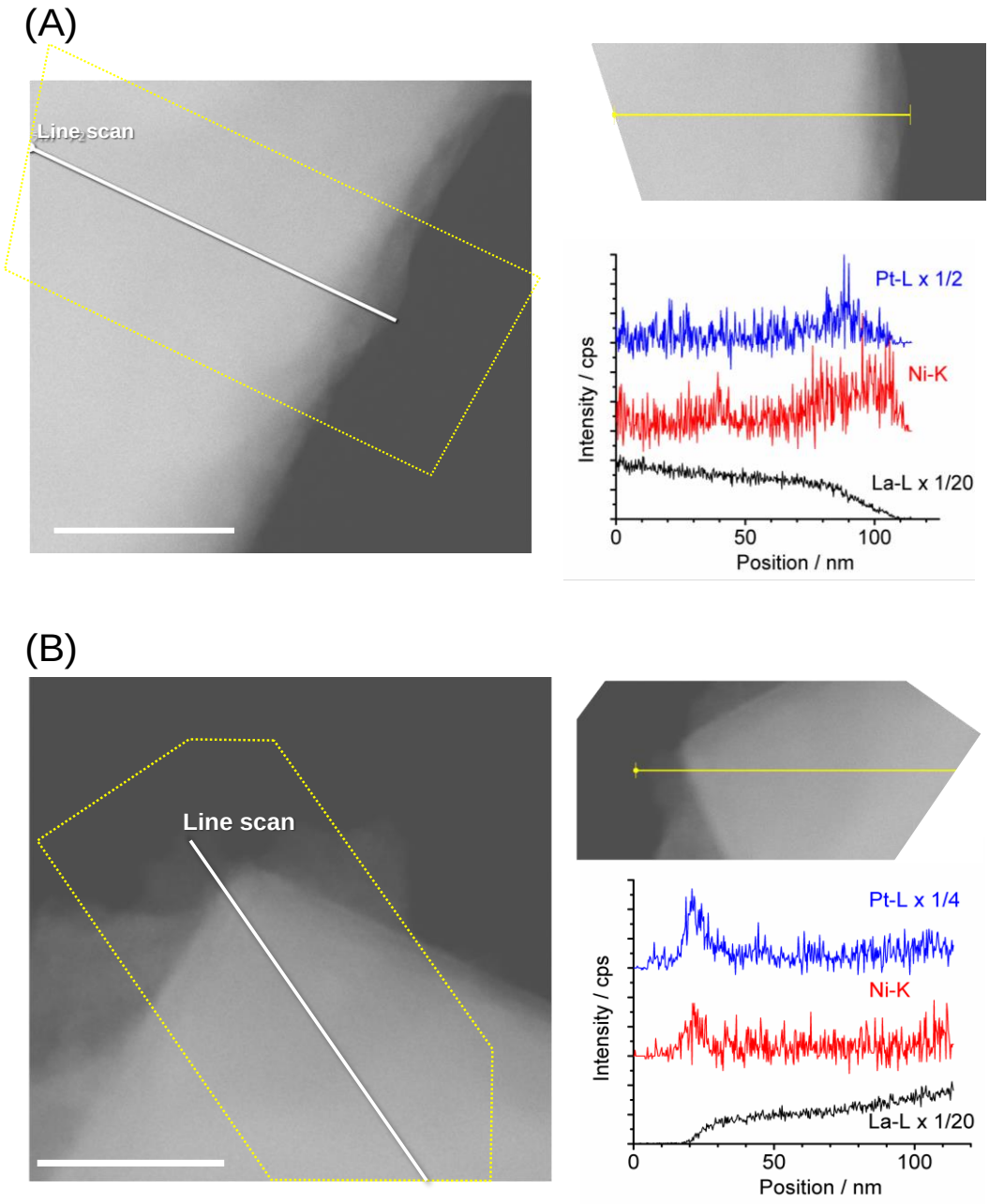

Figure S10. EDS line analyses of (A) LTCSO, and (B) $LTCS_{0.8}Se_{0.2}O$ coloaded with Pt and NiS after a photocatalytic reaction under visible light irradiation (λ > 420 nm). The scale bars in the images are 50 nm.