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Electronic supplementary information

Continuous solid solutions of $Na_{0.5}La_{0.5}TiO_3$–$LaCrO_3$ for photocatalytic H_2 evolution under visible-light irradiation

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Calculation of quantum efficiency

The quantum efficiency (Φ) of photocatalytic H_2 evolution on NaLaTiCrO−0.3 should be ideally calculated according to Eq. S1 [S1-S4]:

$$\Phi = \frac{\text{Number of } H_2 \text{ evolved} \times 2}{\text{Number of photons absorbed}} \quad \text{(S1)}$$

However, it is hard to determine the number of photons absorbed by a photocatalyst in a dispersed system due to non-negligible light scattering. As an alternative, the number of incident photons, which is easily determined by using a spectroradiometer, is generally employed to estimate the so-called apparent quantum efficiency (Φ_a) according to Eq. S2 [S4-S7]:

$$\Phi_a = \frac{\text{Number of } H_2 \text{ evolved} \times 2}{\text{Number of incident photons}} = \frac{\text{Rate of } H_2 \text{ evolved} \times 2}{\text{Photon flux of incident light}} \quad \text{(S2)}$$

It is obvious that the apparent quantum efficiency is the lower limit and a conservative estimate of the absolute value of quantum efficiency.

The rate of H_2 evolved on NaLaTiCrO−0.3 was 2.81 μmol h^{-1} under the irradiation of visible light by using a band-pass filter (λ = 425±10 nm). The photon flux of incident light was determined as described below.

The irradiance (E) of incident light by using a band-pass filter (λ = 425±10 nm) was measured by a spectroradiometer (AvaSpec-2048-USB2, Avantes, Netherlands) to obtain an average value of 5598 μW cm^{-2}. The photon irradiance (E_p) of incident light was calculated according to Eq. S3 to obtain a value of 71.60 μmol h^{-1} cm^{-2}.

$$E_p = \frac{E}{h\nu N_A} = \frac{E\lambda}{hcN_A} \quad \text{(S3)}$$

in which E_p, E, h, ν, N_A, λ, and c represent the photon irradiance, irradiance, Planck's constant, light frequency, Avogadro constant, wavelength, and speed of light, respectively. The photon flux of incident light was calculated by multiplying the photon irradiance by irradiated area (13.85 cm^2) to obtain a value of 991.7 μmol h^{-1}.

Finally, the apparent quantum efficiency of photocatalytic H_2 evolution on NaLaTiCrO−0.3 was estimated to be 0.57% at 425 nm.

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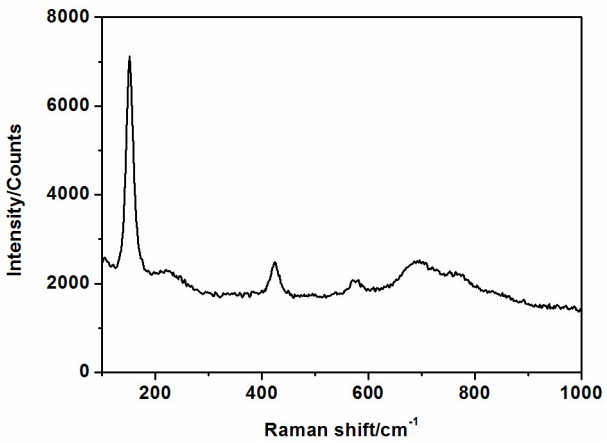

Fig. S1 Raman spectrum of as-prepared $LaCrO_3$.

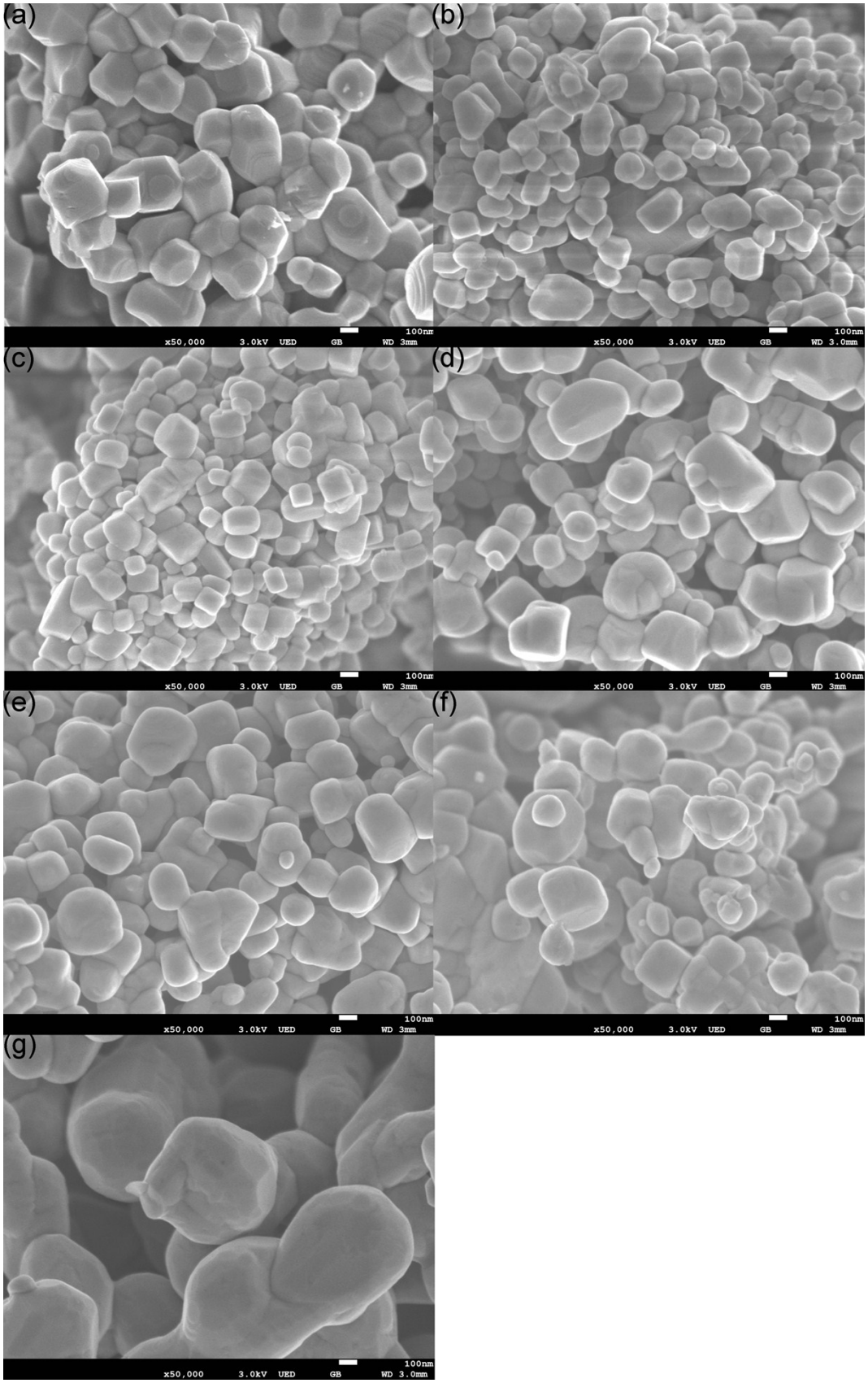

Fig. S2 SEM images of NaLaTiCrO−*x* samples with *x* equal to (a) 0.0, (b) 0.1, (c) 0.2, (d) 0.3, (e) 0.4, (f) 0.5 and (g) 1.0.

Table S1 BET surface areas of NaLaTiCrO−*x* samples.

x value	0.0	0.1	0.2	0.3	0.4	0.5	1.0
BET surface area/$m^2\ g^{-1}$	0.93	2.99	2.92	2.72	2.45	2.90	1.90