

1 ***Supporting Information***

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3 **Solar-light Driven Simultaneous Hypochlorous acid and Hydrogen**
4 **Generation over RhCrO_x-loaded SrTiO₃ Photocatalyst Systems**

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15 **Experimental**

16 **Characterization**

17 SrTiO₃:Al particles loaded with/without co-catalyst were characterized by using an X-
18 ray diffractometer (XRD, PANalytical, X'Pert Pro, rotating anode diffractometer, 45 kV,
19 40 mA) with Cu K α radiation ($\lambda_{K\alpha} = 1.5406 \text{ \AA}$), a UV-vis-NIR spectrometer equipped
20 with an integrating sphere (UV-vis. DRS, Jasco, V-670), and a scanning electron
21 microscope (SEM, HITACHI, SU-8220). X-ray photoelectron spectroscopy (XPS) was
22 conducted using a monochromatic Mg $K\alpha$ source ($h\nu = 1253.6 \text{ eV}$) with an acceleration
23 voltage of 8 kV and a current of 10 mA (JEOL, JPS-9000). The analysis chamber pressure
24 was on the order of 10^{-6} Pa. The binding energies were calibrated using the C1s peak
25 (284.8 eV) as a reference.

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27 **Photocatalytic reaction**

28 The photocatalytic HClO and/or H₂ production on SrTiO₃:Al particles loaded
29 with/without co-catalyst was carried out using a screw-top test tube. The temperature of
30 the reaction system was controlled to keep at 25 °C using a water bath. the SrTiO₃:Al
31 particles (10 mg) were added to an aqueous NaCl solution (5 mL), and the light was
32 irradiated from the side of the reactor tube by a simulated solar light (HAL-320, Asahi
33 Spectra Co., Ltd.), where the light intensity was adjusted at 100 mW cm⁻² (AM1.5G).

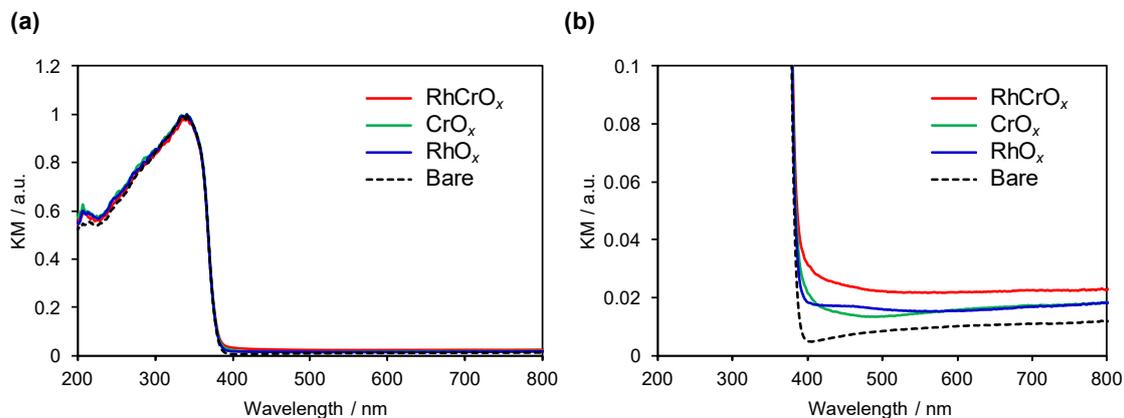
34 In the case of the photocatalytic HClO and/or H₂ production on the SrTiO₃:Al panels
35 loaded with/without co-catalyst, the reactions were carried out in a Pyrex-made reaction
36 vessel, in which the panel was horizontally fixed in 10 mL of aqueous NaCl solution,
37 connected to a closed gas-circulating system.

38 The amounts of HClO produced were analyzed by using the *N, N*-diethyl-*p*-
39 phenylenediamine (DPD) method. The amounts of H₂ produced were analyzed and
40 quantified by using an on-line gas chromatograph (GL Science; GC-3200, TCD, Ar
41 carrier, MS-5A column).

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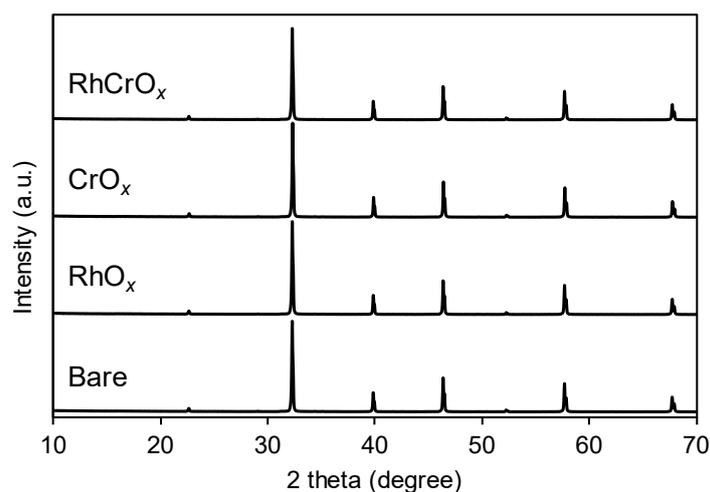
44 Results



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46 **Figure S1.** (a) UV-vis DRS spectra of the SrTiO₃:Al photocatalysts with/without co-
47 catalyst (RhO_x, CrO_x, and RhCrO_x). (b) The y-axis is the magnified. Loading amount of
48 co-catalyst: 0.1 wt%

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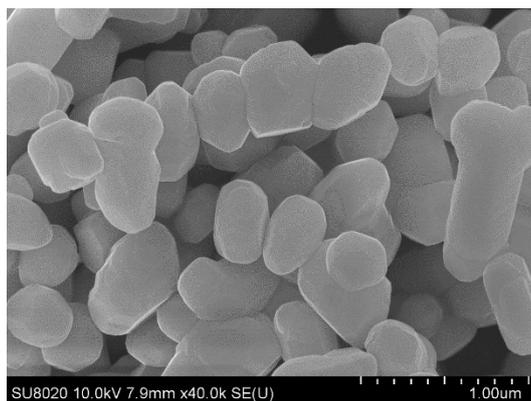


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51 **Figure S2.** XRD patterns of the SrTiO₃:Al photocatalysts with/without co-catalyst (RhO_x,
52 CrO_x, and RhCrO_x). Loading amount of co-catalyst: 0.1 wt%

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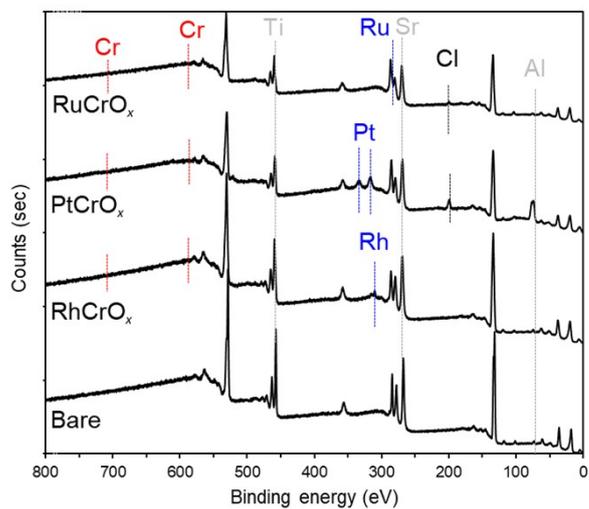


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56 **Figure S3.** SEM image of RhCrO_x/SrTiO₃:Al photocatalyst prepared *via* flux synthesis.

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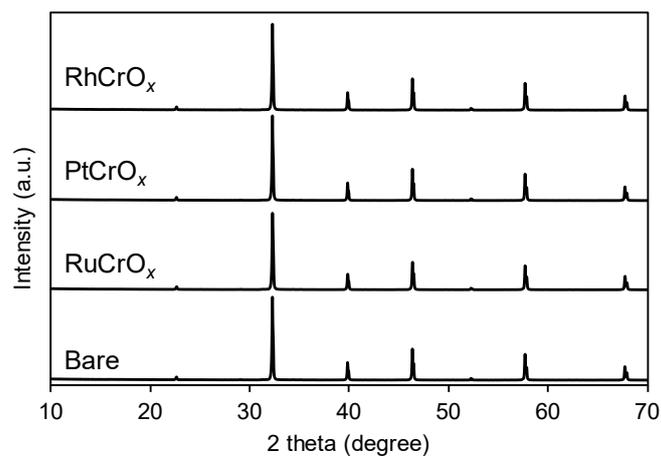
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60 **Figure S4.** XPS spectra of the SrTiO₃:Al photocatalysts with/without co-catalyst
61 (RhCrO_x, PtCrO_x, and RuCrO_x). Loading amount of co-catalyst: 0.1 wt%

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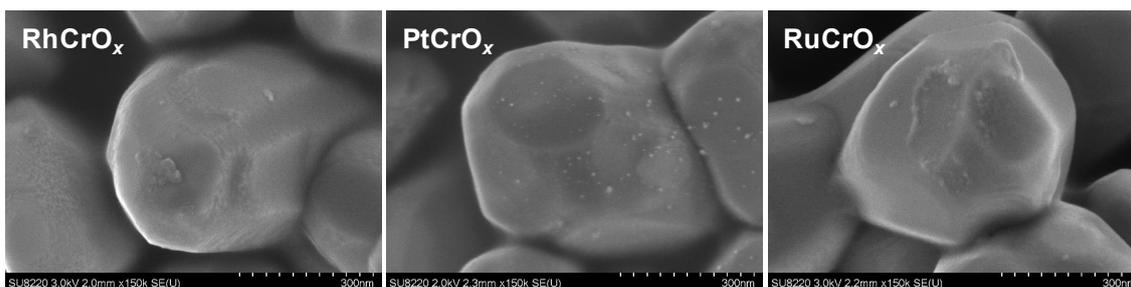


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64 **Figure S5.** XRD patterns of the SrTiO₃:Al photocatalysts with/without co-catalyst
 65 (RhCrO_x, PtCrO_x, and RuCrO_x). Loading amount of co-catalyst: 0.1 wt%

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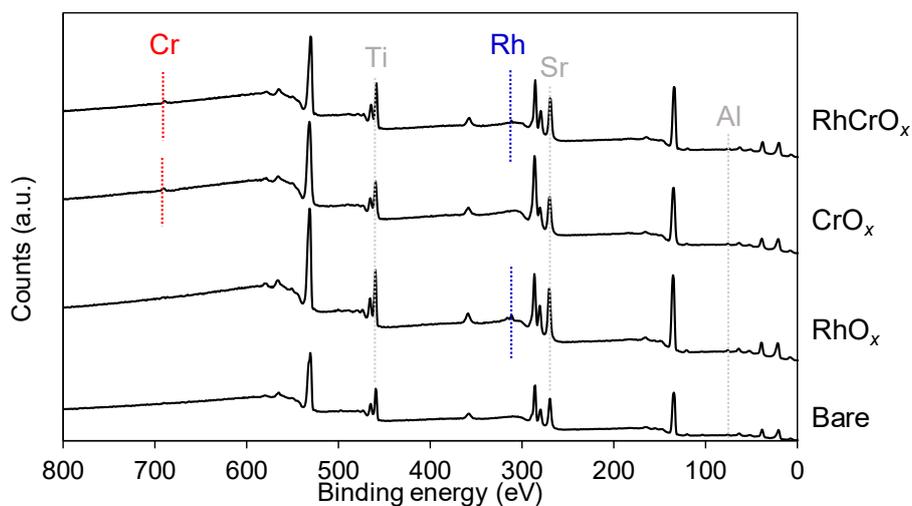
69 **Figure S6.** SEM images of SrTiO₃:Al with co-catalyst (RhCrO_x, PtCrO_x, and RuCrO_x).

70 Loading amount of co-catalyst: 0.1 wt%

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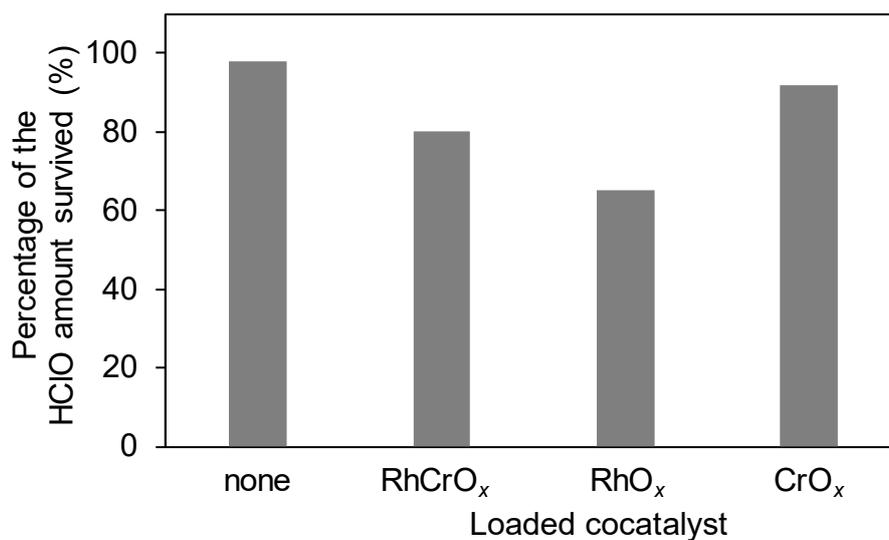


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75 **Figure S7.** XPS spectra of the bare SrTiO₃:Al photocatalyst and those with loading RhO_x,
 76 CrO_x, RhCrO_x cocatalyst.

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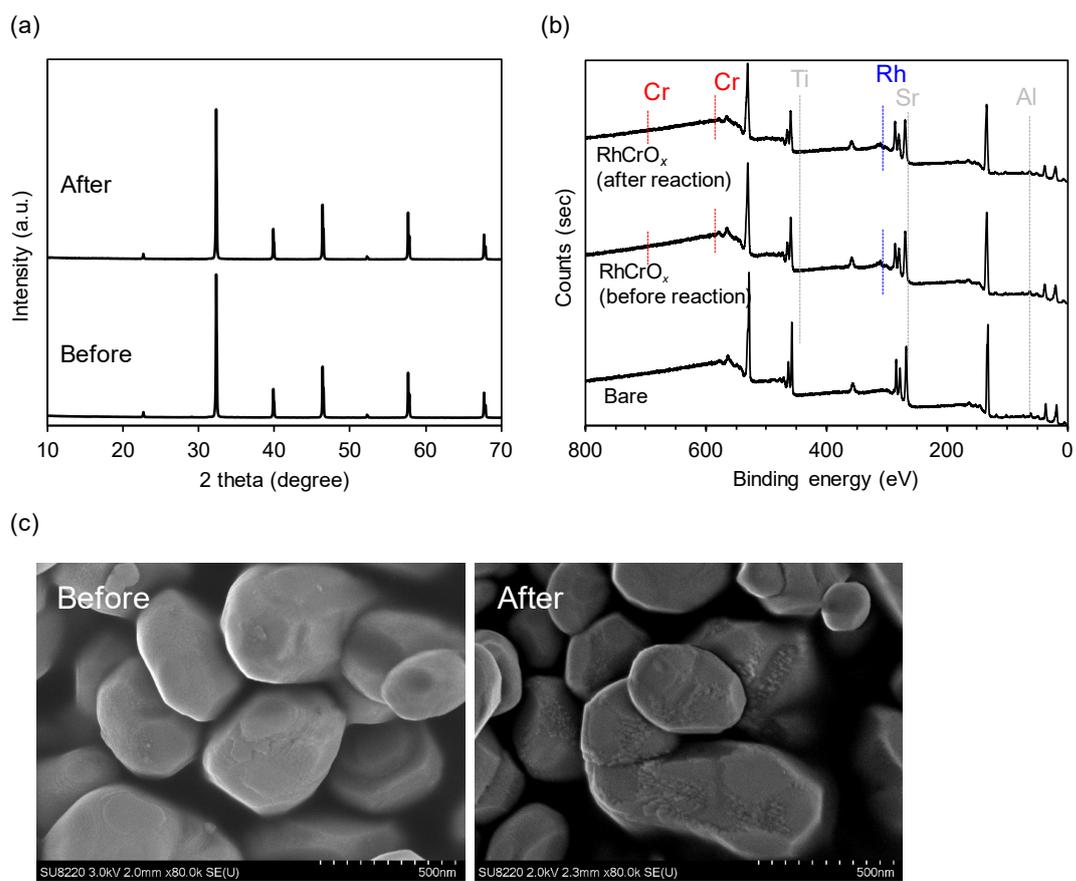
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80 **Figure S8.** Changes in the HClO after the addition of the bare SrTiO₃:Al photocatalyst,
 81 and RhO_x, CrO_x, and RhCrO_x loaded ones in the aqueous NaCl solution that HClO (0.05
 82 mmol) was initially added.

83 Catalyst, 0.01 g; reactant solution, 5 mL of 1M aqueous NaCl solution; dark condition.

84 Reaction time; 4 h

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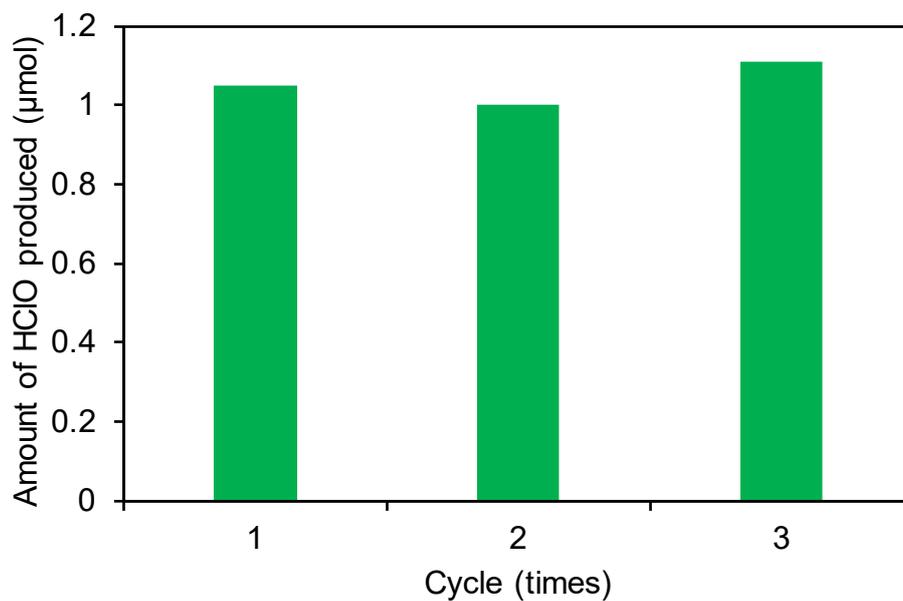


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87 **Figure S9.** (a) XRD patterns, (b) XPS spectra, and (c) SEM images of the
 88 $\text{RhCrO}_x/\text{SrTiO}_3:\text{Al}$ photocatalysts before/after the reaction.

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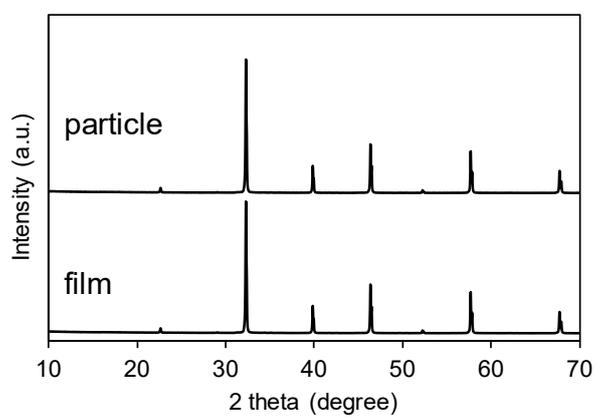
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92 **Figure S10.** Recyclability of RhCrO_x/SrTiO₃:Al photocatalyst in the 1 M of aqueous
 93 NaCl solution under solar-light irradiation. Catalyst, 0.01 g; reactant solution, 5 mL of
 94 aqueous NaCl solution; light source, simulated solar light (AM 1.5G); Irradiation time,
 95 1h.

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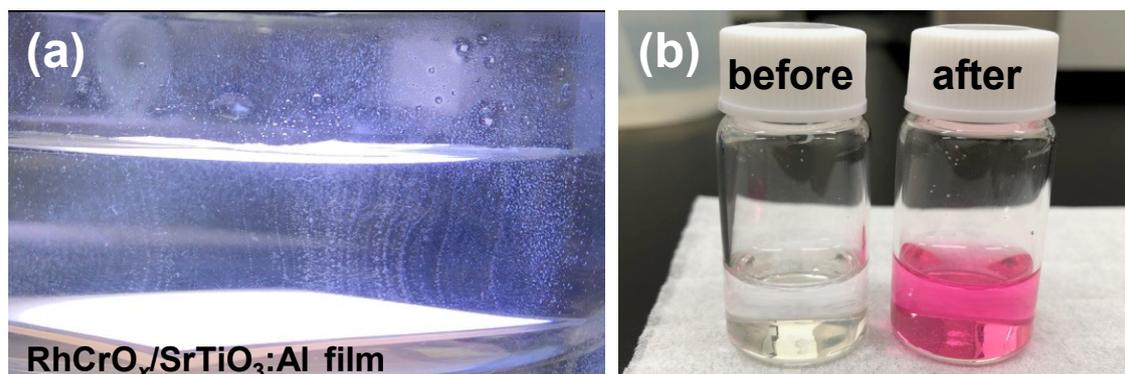


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98 **Figure S11.** XRD patterns of the RhCrO_x/SrTiO₃:Al particle and film.

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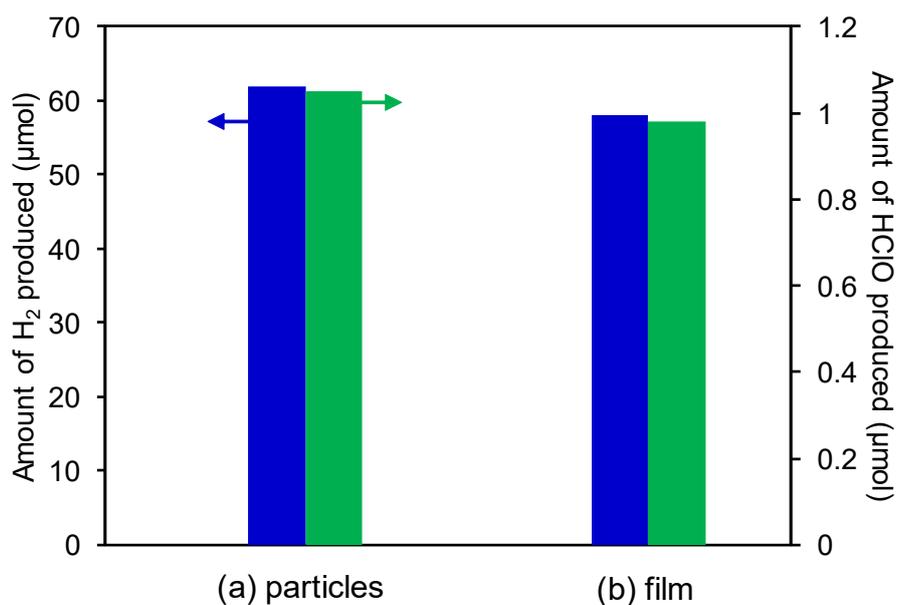


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102 **Figure S12.** Photograph of (a) H₂ production over the RhCrO_x/SrTiO₃:Al film in an
 103 aqueous NaCl solution under UV-light irradiation and (b) before/after the reaction
 104 solution to which DPD reagent was added.

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108 **Figure S13.** The H₂ and HClO production amounts on the (a) RhCrO_x/SrTiO₃:Al film
 109 and (b) particles. A 2.5 × 2.5 cm sheet in which contains 10 mg of RhCrO_x/SrTiO₃:Al
 110 photocatalyst, and 10 mg of particles were used for the reaction. Reaction conditions: co-
 111 catalyst, RhCrO_x; solution, 10 mL of NaCl aq.; light source, simulated solar light
 112 (AM1.5G).