Electronic Supplementary Material (ESI) for Chemical Science
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Supporting Information

Photoeletrochemical properties of $LaTiO_2N$ electrodes prepared by particle transfer for sunlight-driven water splitting

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Preparation of $LaTiO_2N$ electrodes through the particle transfer (PT) method

The $LaTiO_2N$ particles were deposited on a 10×10 mm sized glass plate in the form of a 2-propernol dispersion with a concentration of 50 g L^{-1}. The glass plate was then placed in a vacuum chamber with a base pressure of $<10^{-3}$ Pa. The contact and conductor layers were deposited by RF magnetron sputtering at an RF power of 150 and 200 W, respectively, an Ar pressure of 0.08 Pa and a sample temperature of 623 K. Deposition time was 5 min for the contact layer and 3 h for the conductor layer. The contact layer and the conductor layer thickness were estimated to be 120-300 nm for all the materials examined (see Table S1) and ~8 μm. To make PEC measurements, the prepared photoelectrodes were fixed on another glass plate as support using epoxy resin, followed by connection to a lead wire using In. Finally, the unnecessary parts of the assembled photoelectrode were covered with epoxy resin.

Table S1 Thickness of contact layers.

Ta	190 nm
Ti	160 nm
Zr	120 nm
Nb	260 nm

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Light sources used in photoelectrochemical (PEC) measurements

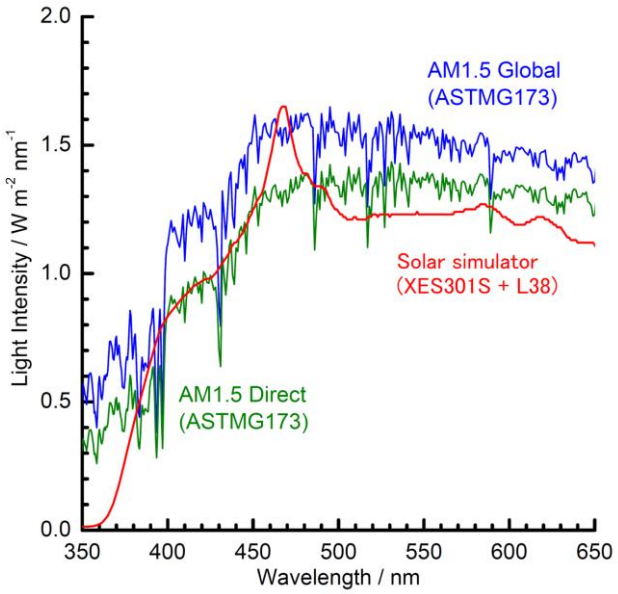

Fig. S1 The spectrum of used solar simulator. As a solar simulator, the commercially-supplied solar simulator (SAN-EI ELECTRIC, XES301S) equipped with cut-off filter (HOYA, L38) was employed. The spectrum of the solar simulator shown in FigS1 is calibrated to AM1.5 Direct (AM1.5D).

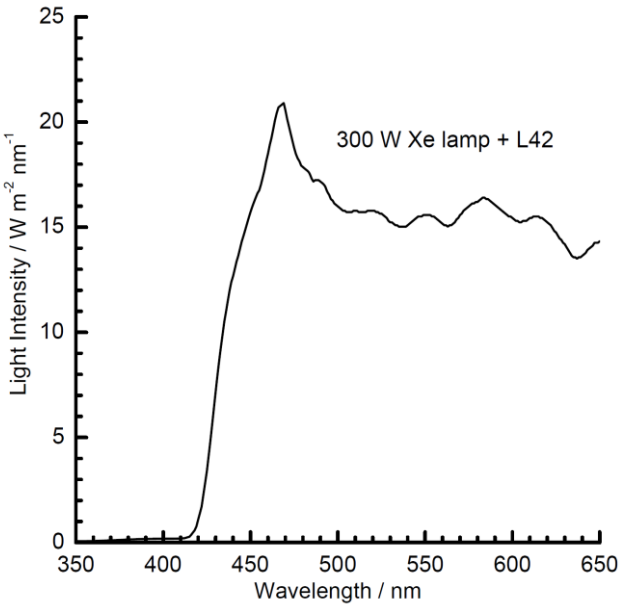

Fig. S2 The spectrum of 300 W Xe lamp equipped with cut-off filter (HOYA, L42).

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XPS analysis results of the $IrO_2/LaTiO_2N$ electrode

XPS was performed on the $IrO_2/LaTiO_2N$ electrode prepared by the PT-method with a contact layer and conductor layer of Ta and Nb, respectively. The XPS results of the electrode before and after the ageing treatment are shown in Fig. S3. The aging treatment was performed at 1.0 V_{RHE} in 1 M Na_2SO_4 aqueous solution（pH = 6）under irradiation from a 300 W Xe lamp equipped with cut-off filter (HOYA, L42) and cold mirror for 30 min.

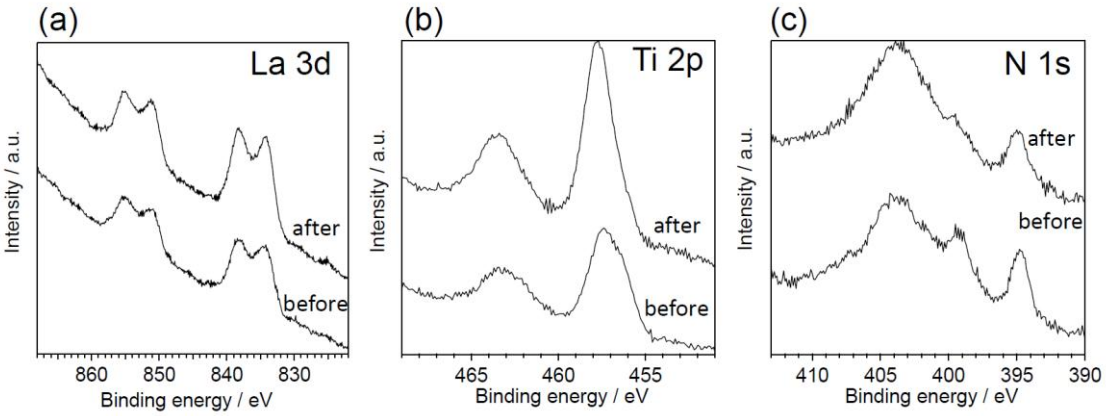

Fig. S3 XPS results for La3d, Ti2p and, N1s of electrodes with modifying IrO_2 colloids. The binding energies determined by XPS were corrected in reference to the C 1s peak (284.6 eV).

Table S2 The surface composition estimated from XPS results.

	La / Ti	N / Ti
Before	0.67	0.63
After	0.56	0.28

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Time course of photocurrent from IrO_2/$LaTiO_2N$/Ta/Ti under AM1.5D

The time course of photocurrent from IrO_2/$LaTiO_2N$/Ta/Ti under AM1.5D measured after *I-E* curve measurement are shown in Fig. S4.

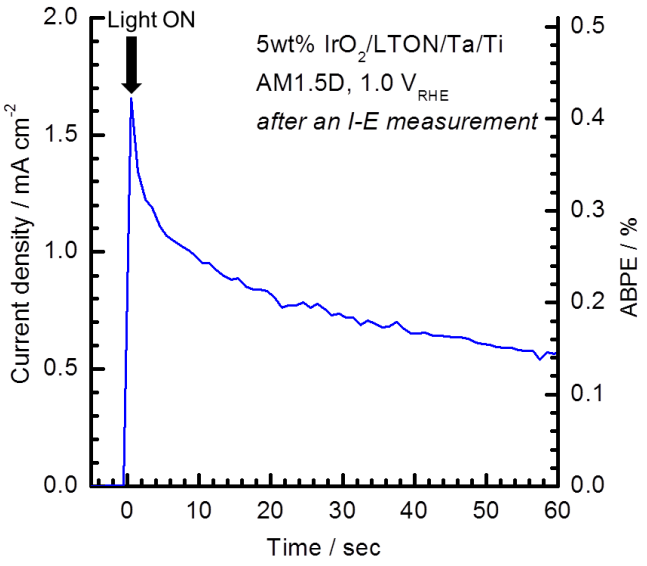

Fig. S4 Time courses of photocurrent from IrO_2-loaded $LaTiO_2N$ electrodes with a Ta contact layer between the $LaTiO_2N$ particles and the Ti conductor layer. Conversion efficiencies in ABPE at actual photocurrent are shown on the right side Y-axis. The electrolyte was a 1 M aqueous Na_2SO_4 solution with pH adjusted to 13.5 by NaOH addition. The commercially-supplied solar simulator (SAN-EI ELECTRIC, XES301S) equipped with cut-off filter (HOYA, L38) was used as a light source (Fig. S1). The electrode potential was set to 1.0 V_{RHE} during these measurements.

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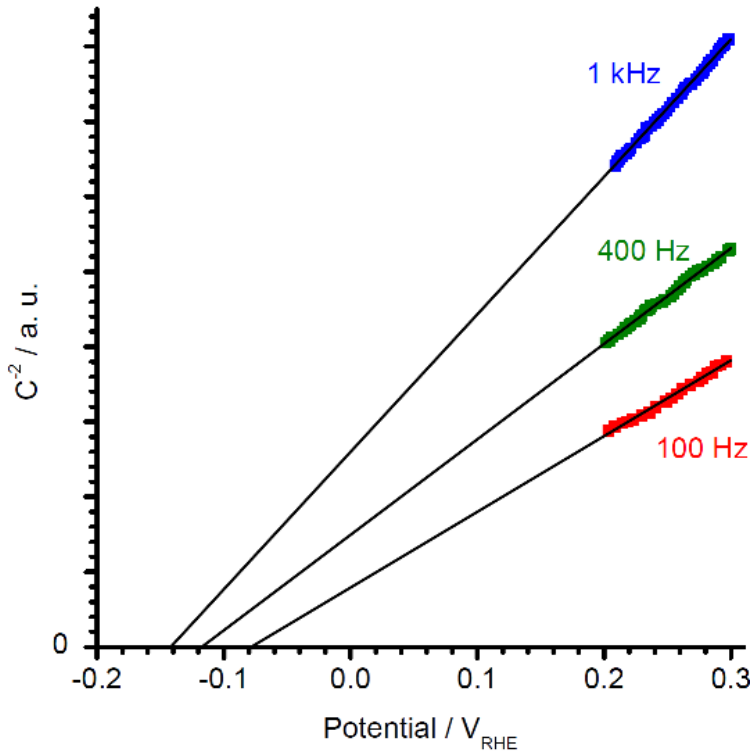

Fig. S5 Mott-Schottky plot of the $LaTiO_2N$/Ta electrode in 1 M aqueous Na_2SO_4 solution (pH = 6). The flat band potential was estimated to be -0.08 to -0.14 V_{RHE} by extrapolating C^{-2} to 0.