Supporting Information for

Semiconductor monolayer assemblies with oriented crystal faces

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Supplementary Methods
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Supplementary Methods

Commercialized products of TiO_2 (rutile), $SrTiO_3$ and ZnO.

TiO_2 (Rutile) is from Wako Pure Chemical Industries, Ltd. with a purity of 99%.

$SrTiO_3$ is from Kojundo Chemical Laboratory Co., Ltd. with a purity of 99%.

ZnO is from Kanto Chemical Co., Inc. with a purity of 99%.

Synthesis of $BaTaO_2N$ powder.

$BaTaO_2N$ powder was prepared by a conventional nitridation method. $BaCO_3$ and Ta_2O_5 powders purchased from Kanto Chemical Co. and High Purity Chemical Co., respectively, were mixed by grinding in an agate mortar with a molar ratio of 2:1. The mixture was loaded into an alumina boat and subsequently inserted into the center of a horizontally placed alumina tube furnace with an inner diameter of 24 mm. Then, the sample was heated under dry NH_3 flow at 200 mL min-1 at 1173 K for 20 h with intermediate grinding. The obtained sample will be referred to as $BaTaO_2N$(SSR). Post-treatment of $BaTaO_2N$(SSR) was carried out as the next step. A flux of NaCl was added to $BaTaO_2N$(SSR), and then mixed by grinding in an agate mortar. Then, the mixture was subjected to heat-treatment under dry NH_3 flow at 100 mL min-1 in a tubular furnace at 1073 K. The final products were washed with distilled water to remove residual flux.

Synthesis of small-particle $LaTiO_2N$ powder.

All of the reagents were analytical grade and used without further purification. The oxide precursor of $La_2Ti_2O_7$ was prepared by a polymerized complex (PC) method[2], and then $LaTiO_2N$ was obtained by heating $La_2Ti_2O_7$ under NH_3 flow (200 mL min^{-1}) at 950 ^oC for 15 h.

Synthesis of large-particle $LaTiO_2N$ powder.

All of the reagents were analytical grade and used without further purification. The oxide precursor of $La_2Ti_2O_7$ was prepared by molten salt[3]. In a typical preparation procedure, La_2O_3 and TiO_2 were mixed in a molar ratio of 1:2 and a salt of composition 50 mol% NaC1 and 50 mol% KCI was then added, constituting 50 wt% of the total reaction mixture. The mixture was then heated up to 1150 ^oC at a rate of 10 ^oC/min and maintained at 1150 ^oC for 5 hours, the temperature was cooled down to 800 ^oC at 10 ^oC/min and then cooled down to room temperature naturally. The calcined mixture was added into water to dissolve the salt. Crystallized $La_2Ti_2O_7$ powder was obtained by filtrating the above aqueous solution and then dried at 200 ^oC for using. To prepare $LaTiO_2N$, the $La_2Ti_2O_7$ precursor was nitrided at 950 ^oC for 15 h under a NH_3 flow.

Characterization of products

The as-prepared samples were characterized by X-ray powder diffraction (XRD, Geiger-flex RAD-B, Rigaku; Cu Kα) and field-emission scanning electron microscopy (FE-SEM; S-4700, Hitachi).

References:

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Supplementary table 1: Calculated ratio of relative peak intensity of the XRD showed in fig.2

	I_{101}:I_{110}	I_{111}:I_{110}	I_{211}:I_{110}	I_{220}:I_{110}	I_{301}:I_{110}
TiO_2 powder	0.379	0.181	0.356	0.102	0.082
TiO_2/GP	0	0	0	0.051	0
	I_{100}:I_{110}	I_{111}:I_{110}	I_{200}:I_{110}	I_{211}:I_{110}	I_{220}:I_{110}
$SrTiO_3$ powder	0.037	0.185	0.311	0.204	0.087
$SrTiO_3$/GP	3.23	0.467	15.3	0	0
	I_{002}:I_{100}	I_{101}:I_{100}	I_{102}:I_{100}	I_{110}:I_{100}	I_{103}:I_{100}
ZnO powder	0.671	1.57	0.285	0.388	0.288
ZnO/GP	0.041	0	0	0	0
	I_{100}:I_{200}	I_{110}:I_{200}	I_{211}:I_{200}	I_{220}:I_{200}	I_{310}:I_{200}
$BaTaO_2N$ powder	0.266	5.07	1.02	0.311	0.218
$BaTaO_2N$/GP	0.417	0	0	0	0

Supplementary table 2: Calculated ratio of relative peak intensity of the XRD showed in fig.4

	I_{002}:I_{112}	I_{202}:I_{112}	I_{004}:I_{112}	I_{114}:I_{112}	I_{204}:I_{112}
$LaTiO_2N$ powder-LP	0.274	0.162	0.174	0.047	0.145
$LaTiO_2N$/GP-LP	0.012	0	0.008	0	0
$LaTiO_2N$ powder-SP	0.186	0.165	0.177	0.034	0.150
$LaTiO_2N$/GP-SP	319	8.02	201	0	0