

Supporting Information

Highly conductive nano-sized Magnèli phases titanium oxide (TiO_x)

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1. Raw data of XAFS spectra

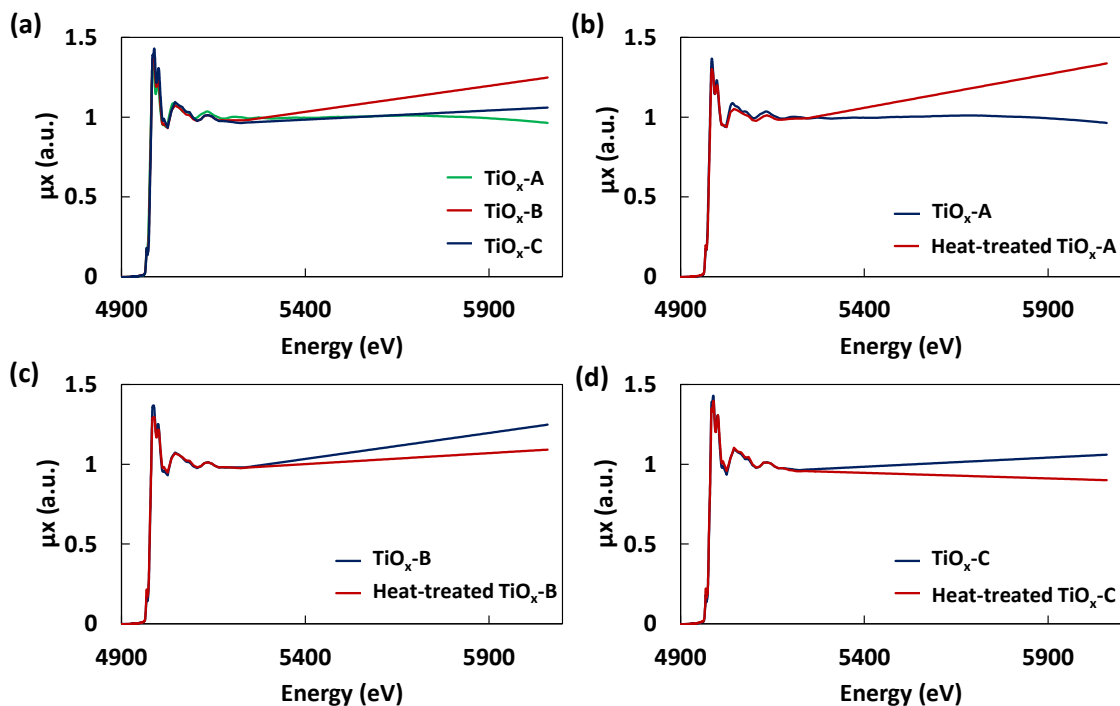


Figure S1. XAFS spectra of (a) TiO_x-A, TiO_x-B, and TiO_x-C, and comparison of XAFS spectra before and after heat-treatment of (b) TiO_x-A, (c) TiO_x-B, and (d) TiO_x-C.

2. Raw data of XAFS spectra

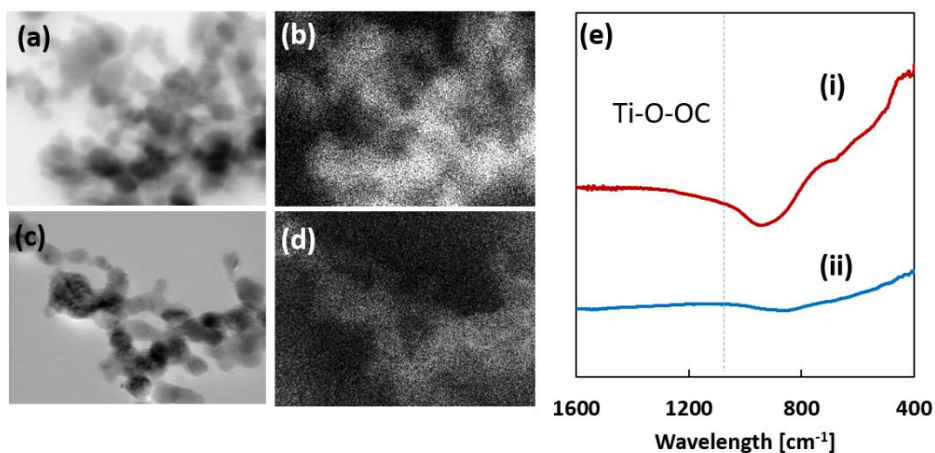


Figure S2. TEM image and carbon elemental mapping of (a, b) TiO_x-A and (c, d) heat-treated TiO_x-A show a reduction in the carbon intensity after heat treatment. This result is aligned with (e) FT-IR spectrum of (i) TiO_x-A and (ii) heat-treated TiO_x-A which show a significant decrease in the Ti-O-OC peak intensity at 1103 cm⁻¹ after heat treatment.

3. Phase identification from XRD spectra

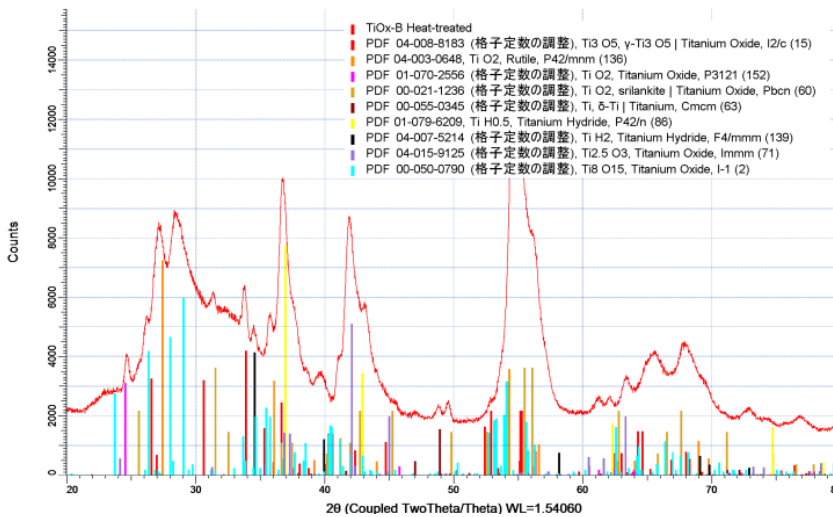
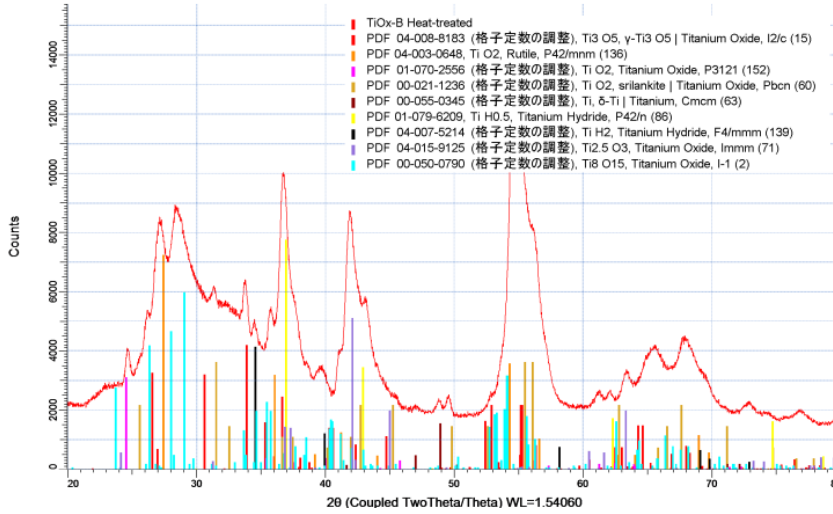
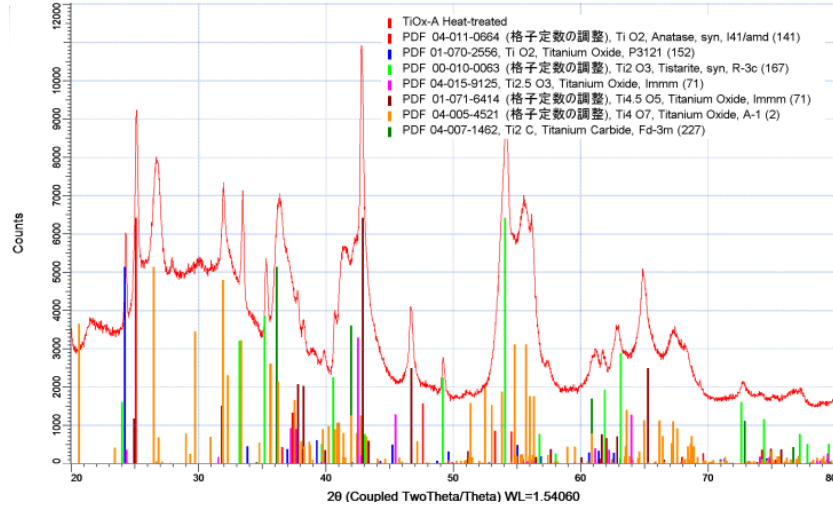


Figure S3. Raw XRD spectra and peak assignment of heat-treated (a) TiO_x-A, (b) TiO_x-B and (c) TiO_x-C

Table S1. Summary of identified phases in TiO_x-A from XRD analysis

Phase	PDF No.	As-synthesized	Heat-treated
TiO ₂	04-011-0664	√	√
TiO ₂	01-070-2556	√	√
Ti ₂ O ₃	00-010-0063	√	√
Ti _{2.5} O ₃	04-015-9125	-	√
Ti _{4.5} O ₅	01-071-6414	√	√
Ti ₄ O ₇	04-005-4521	√	√
Ti ₂ C	04-007-1462	√	√

Table S2. Summary of identified phases in TiO_x-B from XRD analysis

Phase	PDF No.	As-synthesized	Heat-treated
Ti ₃ O ₅	04-008-8183	√	√
Ti _{2.5} O ₃	04-015-9125	-	√
TiO ₂ (rutile)	04-003-0648	√	√
TiO ₂ (P3121)	01-070-2556	√	√
TiO ₂ (srilankite)	00-021-1236	√	√
Ti	00-055-0345	√	√
Ti ₄ O ₇	04-005-4521	√	-
TiH _{0.5}	01-079-6209	√	√
TiH ₂	04-007-5214	-	√
Ti ₈ O ₁₅	00-050-0790	-	√
Ti _{0.374} O _{0.5} (OH) _{0.5} (kleberite)	01-076-5388	√	√

Table S3. Summary of identified phases in TiO_x-C from XRD analysis

Phase	PDF No.	As-synthesized	Heat-treated
Ti ₃ O ₅	04-008-8183	√	√
Ti _{4.5} O ₅	01-071-6414	√	√
TiO ₂ (rutile)	04-003-0648	√	√
TiO ₂ (P3121)	01-070-2556	√	√
TiO ₂ (srilankite)	00-021-1236	√	√
Ti ₂ O ₃	00-010-0063	√	√

Ti ₄ O ₇	04-005-4521	√	√
TiH _{0.5}	01-079-6209	√	√
TiH ₂	04-007-5214	-	√
Ti ₈ O ₁₅	00-050-0790	√	-
TiC ₈	00-051-0622	-	√
Ti _{0.374} O _{0.5} (OH) _{0.5} (kleberite)	01-076-5388	√	√

4. Electrochemical characteristics of Ti₄O₇ synthesized *via* high temperature H₂ reduction of rutile TiO₂

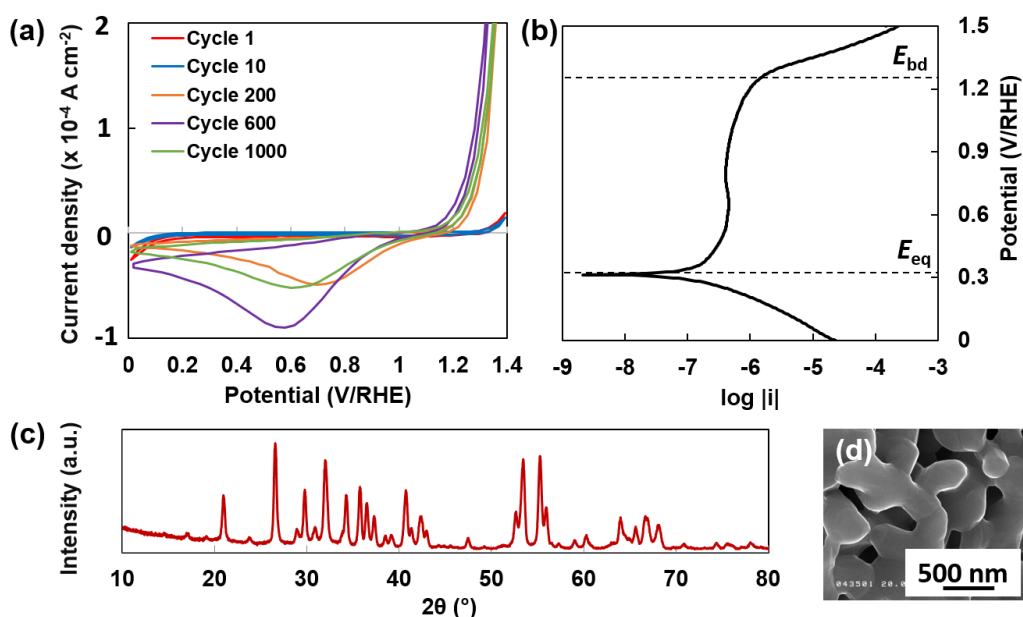


Figure S4. (a) cyclic voltammogram and (b) potentiodynamic curve of Ti₄O₇ in oxygen-saturated 1M HCl. (c) XRD spectra of Ti₄O₇ sample showing Ti₄O₇ peaks (Ref. ICDD No. 50-787) and (d) SEM images of Ti₄O₇ particles

Table S4. Comparison of electrochemical characteristics of TiO_x-A and Ti₄O₇

No	Parameter	Unit	TiO _x -A	Ti ₄ O ₇
1.	E_{eq}	(V/RHE)	0.11	0.31
2.	E_{bd}	(V/RHE)	1.3	1.3
3.	Corrosion current density	A cm ⁻²	5.37×10^{-7}	1.58×10^{-7}
4.	Corrosion rate	mm per year	0.006	0.00005