

# Supplementary Materials: A Clean Process to Prepare High-Quality Acid-Soluble Titanium Slag from Titanium Middling Ore

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**Table S1.** List of the preparation methods of synthetic rutile.

Feedstock	Method	Reference
Sulfated ilmenite	Selective thermal decomposition (500–560 °C)-sulfuric acid leaching (15 wt %)-NaOH leaching (5 wt %)	[7]
Ilmenite	Roasting with (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> (360 °C)-selective thermal decomposition (480 °C)-hydrochloric acid leaching (2.5 wt %)-NaOH leaching (5 wt %)	[9]
Titanium slag	Microwave roast (700–1100 °C)	[10–12]
Ilmenite	Anion-exchange (IRA 410 Cl)	[13]
Titanium slag	Molten modification (2% B <sub>2</sub> O <sub>3</sub> amount)-hydrochloric acid leaching (4 wt %)-NaOH leaching (8 wt %)	[16]
Titanium slag	Soda ash roasting (850–900 °C)-water leaching-acid leaching-alkali leaching	[8,15]
Titanium slag	H <sub>3</sub> PO <sub>4</sub> oxidation (1000 °C)-reduction (800 °C)-hydrochloric acid (20 wt %)-NaOH leaching	[14]
Titanium slag	Oxidizing with additives- hydrochloric acid leaching (6–8 wt %)	[17]
Ilmenite	Partial reduction-acid leaching	
Ilmenite	Full reduction-corrosion	

**Table S2.** Verification experiments of predominant species (L/S 4).

pH of Leaching Solution	Leaching Temperature (°C)	Leaching Time (h)	Reactant	Whether Reactant Dissolves
1	25	1	Al <sub>2</sub> O <sub>3</sub>	Yes
3	25	1	Al <sub>2</sub> O <sub>3</sub>	No
0.5	100	1	Al <sub>2</sub> O <sub>3</sub>	Yes
1.5	100	1	Al <sub>2</sub> O <sub>3</sub>	No
14	100	1	Al <sub>2</sub> O <sub>3</sub>	Yes
10	25	1	MgO	Yes
12	25	1	MgO	NO
7	100	1	MgO	Yes
9	100	1	MgO	No
1	25	1	VO <sub>2</sub>	Yes
3	25	1	VO <sub>2</sub>	No
0.5	100	1	VO <sub>2</sub>	Yes
1.5	100	1	VO <sub>2</sub>	No
8	25	3	CaTiO <sub>3</sub>	No
10	25	3	CaTiO <sub>3</sub>	No
6	100	3	CaTiO <sub>3</sub>	No
8	100	3	CaTiO <sub>3</sub>	No
3	25	3	FeTiO <sub>3</sub>	No
5	25	3	FeTiO <sub>3</sub>	No
2	100	3	FeTiO <sub>3</sub>	No
4	100	3	FeTiO <sub>3</sub>	No
5	25	3	MnTiO <sub>3</sub>	No
7	25	3	MnTiO <sub>3</sub>	No
4	100	3	MnTiO <sub>3</sub>	No
6	100	3	MnTiO <sub>3</sub>	No

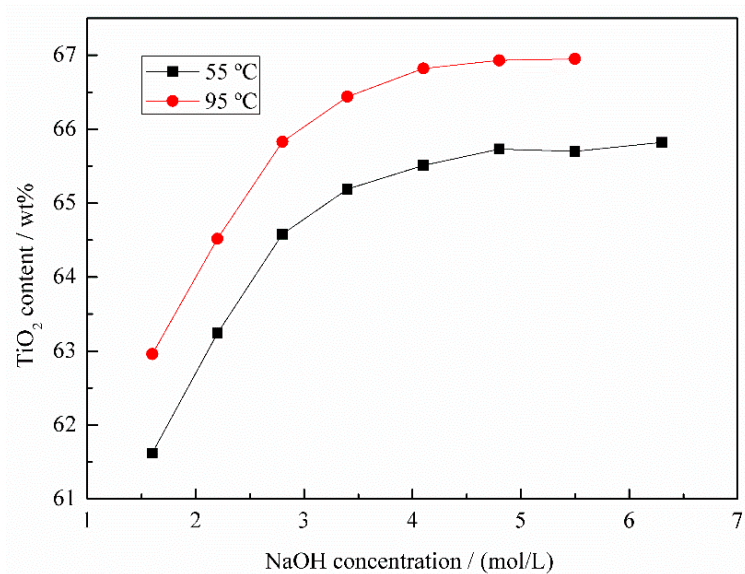


Figure S1. Effects of NaOH concentration on TiO<sub>2</sub> content at 55 °C and 95 °C.

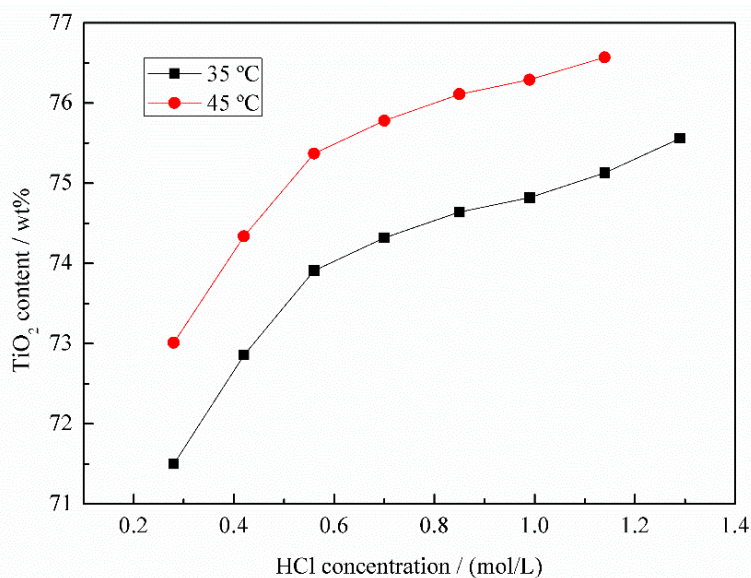
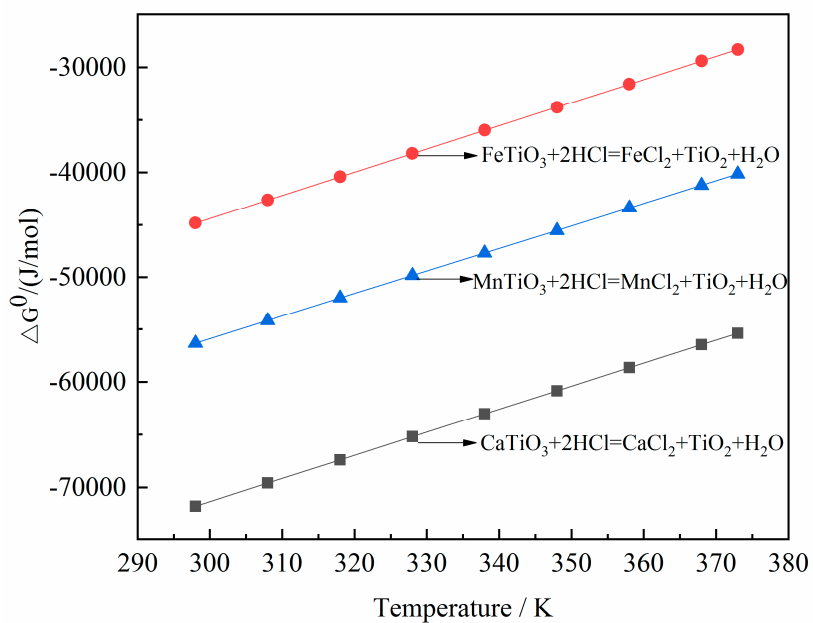


Figure S2. Effects of HCl concentration on TiO<sub>2</sub> content at 35 °C and 45 °C.



**Figure S3.** Standard Gibbs free energy change of reactions.



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