New Ti Production Process Directly from Ti Ore

Development of New Ti Production Process Using Low-grade Ti Ore Selective Chlorination and Fe Removal by Electrochemical Method

New Ti smelting process

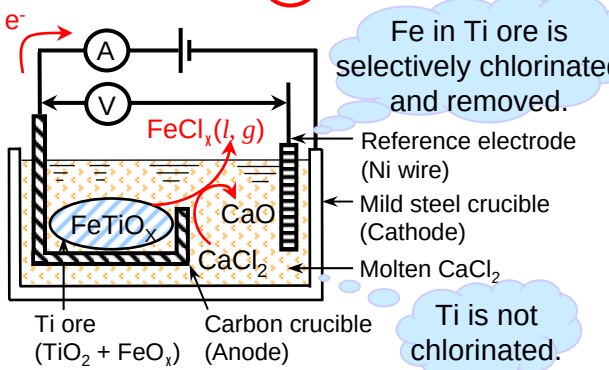
Fe in Ti ore is selectively chlorinated and removed by a new smelting process in which Cl potential in molten salt is controlled by electrochemical method.

1. Selective chlorination, Fe removal

Cathode: $Fe^{n+} + n\,e^- \rightarrow Fe$, $Ca^{2+} + 2\,e^- \rightarrow Ca$

Anode: $2\,Cl^- \rightarrow Cl_2 + 2\,e^-$

$FeO_x\,(FeTiO_x) + Cl_2 \rightarrow FeCl_x(l, g) + O^{2-}$



Fe in Ti ore is selectively chlorinated and removed.

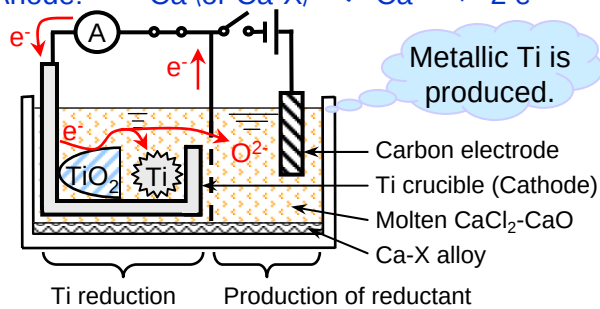
Ti is not chlorinated.

2. TiO_2 reduction process

(Metallic Ti is produced by new reduction process, e.g. EMR/MSE process)

Cathode: $TiO_2 + 4\,e^- \rightarrow Ti + O^{2-}$

Anode: $Ca\,(or\ Ca\text{-}X) \rightarrow Ca^{2+} + 2\,e^-$

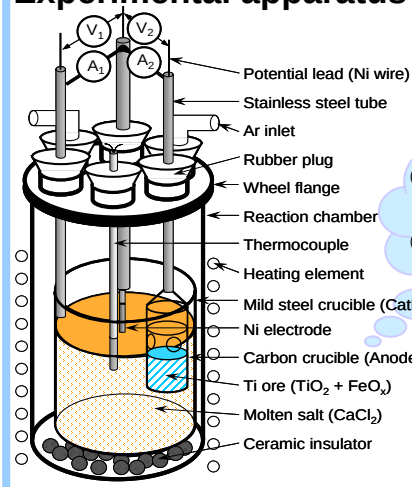


Metallic Ti is produced.

New smelting process for producing metallic Ti directly from Ti ore is under investigation.

Experimental apparatus and result

Experimental apparatus for Fe removal



Advantage of carbon crucible

- ○ Inert at high anodic potential
- ○ Cl potential can be increased.

Fe removal by selective chlorination is possible.
Carbon can not be used for Ti reduction electrode (cathode).

Experimental result

Table Analytical results of Ti ore and residue after selective chlorination.

	Concentration of element *i*, C_i (mass %)[a]			Fe / Ti (%)
	Ti	Fe	Ca	Mass ratio
Before exp.[b]	42.62	48.72	0.33	114.8
After exp.	47.22	3.40	47.92	7.2

a: Determined by XRF analysis.
b: Ilmenite ($FeTiO_x$) from China.

Technique for removing Fe down to ppm level is currently under investigation.

Fe in Ti ore was successfully removed.
Fe removal ratio should be improved.

Selective chlorination and Fe removal in Ti ore by electrochemical method was demonstrated.

Future work

Development of new smelting process for producing metallic Ti directly from Ti ore after Fe removal.

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