New Titanium Production Process

High-speed Titanium Production Process Using Titanium Subhalides
Environmentally Sound Process Utilizing Titanium Scraps

High-speed Ti production process

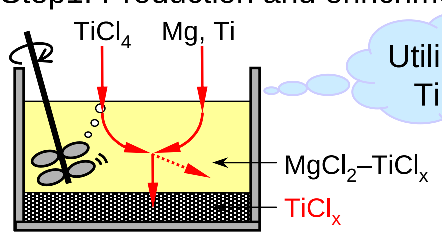
Ti production process using Ti subhalides ($TiCl_x$, x = 2, 3)

① $TiCl_4(l, g) + Mg(l, g) \rightarrow TiCl_x(s, l) + MgCl_2(l)$

$TiCl_4(l, g) + Ti(s, \text{scrap}) \rightarrow TiCl_x(s, l)$

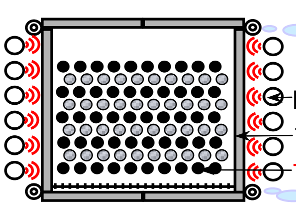
② $TiCl_x(s, l) + Mg(l, g) \rightarrow Ti(s) + MgCl_2(l, g)$

Step1: Production and enrichment of $TiCl_x$



Utilization of Ti scraps

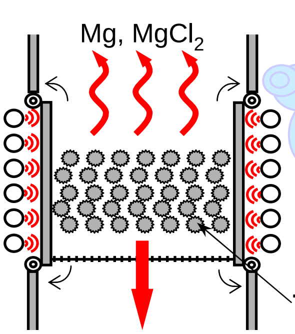
Step2: High-speed reduction of $TiCl_x$



High-speed reaction

High-purity Ti can be produced.

Step3: Removal of reaction product $MgCl_2$



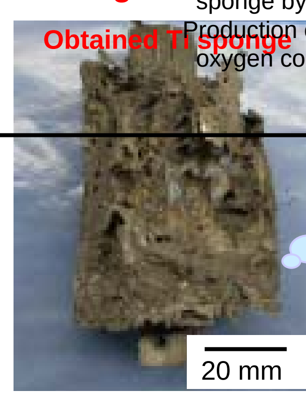
Ti vessel together with product Ti can be directly melted without crushing.

Features and experimental result

Comparison of Kroll process and new process

	Kroll process	New process
Process type	Batch-type, limited speed	**(Semi-)Continuous, high-speed**
Feed material	$TiCl_4$ (l, g)	**$TiCl_2$, $TiCl_3$ (s, l)**
Heat of reduction	High (ΔH = –434 kJ molTi)	**Low (ΔH = –94 ~ –191 kJ molTi)**
Reactor material	Mild steel (Iron contamination unavoidable)	**Titanium (No iron contamination)**
Reactor size	Large (Crush and melt)	**Small (No crush and direct melt)**
Flux, sealant	Not used	Ti, $MgCl_2$
Common features	Magnesiothermic reduction of chlorides Removal of $MgCl_2$ and Mg from Ti sponge by vacuum distillation Production of high-purity Ti with low oxygen content	

Experiment for the magnesiothermic reduction of $TiCl_3$



Ti with 99.2% purity was efficiently obtained using Ti vessel.

New technologies for this process are under development.

Feasibility of new Ti production process based on the magnesiothermic reduction of Ti subhalides using Ti vessel was demonstrated.

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