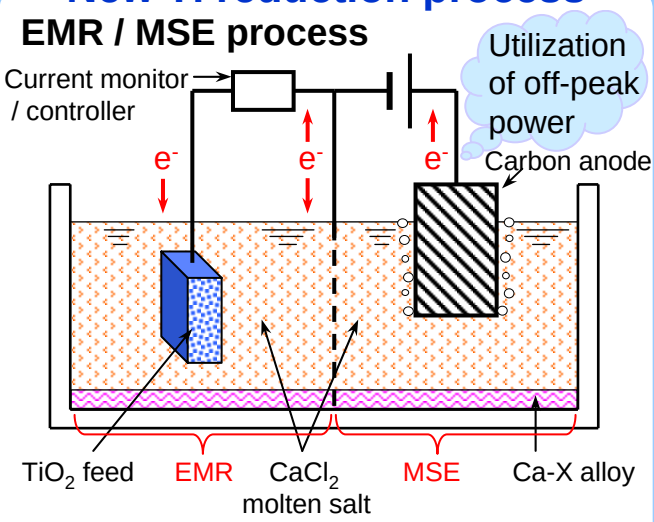
New Titanium Production Process (EMR)

Research on Innovative Technology and New Production Process of Titanium
Conversion of Resource Abundant Rare Metal into Common Metal

New Ti reduction process

EMR / MSE process



EMR: Electronically Mediated Reaction

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

Anode: $Ca \rightarrow Ca^{2+} + 2\,e^-$

MSE: Molten Salt Electrolysis

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

Anode: $C + x\,O^{2-} \rightarrow CO_x + 2x\,e^-$

Overall reaction

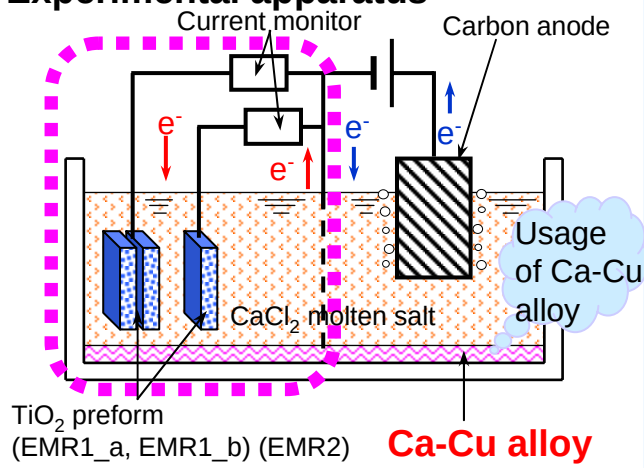
$$TiO_2 + C \rightarrow Ti + CO_2$$

Comparison of the Kroll process and this process

Kroll process	EMR / MSE process
◎ High-purity Ti obtainable	◎ Direct reduction from oxide
○ Established chlorine and Mg circulation	◎ Resistant to iron and carbon contamination
○ Utilization of efficient Mg electrolysis	◎ (Semi-)continuous process
○ Reduction and electrolysis operations can be carried out independently	○ Reduction and electrolysis operations can be carried out independently
×Batch type process	× Utilization of Ca reductant
×Complicated process	× Difficult meal / salt separation when oxide system is used
×Slow production speed	× Complicated cell structure
×Huge exothermmic reaction	△ Complicated process

Demonstration experiment for EMR process

Experimental apparatus



Experimental result

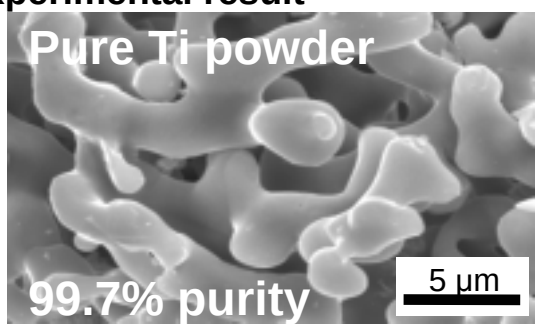


Table Analytical results of obtained Ti powder

	Concentration of element *i*, C_i (mass%)			
	Ti[a]	Ca[a]	Cl[a]	O[b]
EMR1_a	99.7	0.19	(0.09)	0.25
EMR1_b	99.6	0.18	(0.15)	0.37
EMR2	99.7	0.21	(0.08)	-

[a]: Determined by XRF (Detection limit: 300 ppm)
[b]: Determined by inert gas fusion-infrared absorption spectroscopy (LECO) 2500 ppmO

Homogeneous Ti powder free of Cu was obtained even though Ca-20 mol%Cu alloy reductant was used.

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