



OKABE LAB.

[Future Materials: Titanium, Rare Metals]



IIS 2010 Open House

International Research Center for Sustainable Materials

<http://okabe.iis.u-tokyo.ac.jp/>

Materials Chemistry, Environmental Science, Recyclable Resource Engineering,
Rare Metal Process Engineering

Department of Materials Engineering

Changing Rare Metals into "Common" Metals!

New Process for Production of Rare Metals

New Process for Production of Titanium

Ti has excellent specific intensity and corrosion resistance. It is a resourceful future base metal.

Ti production process involving disproportionational reaction of $TiCl_2$ in molten salt

Conventional process (Kroll process)
 $TiCl_4 + 2Mg = Ti + 2MgCl_2 + \text{"Heat"}$

Disproportional reaction
 $2TiCl_2 = Ti + TiCl_4$

Analytical results of the obtained samples after leaching

Exp. No. (pos.)	Total pressure, p(atm)	Crucible	Concentration in Ti sample C_i (atm%)				
			Ti	Mg	Fe	Ni	Cr
A	1	Ni	99.2	<0.01	0.53	0.09	0.15
B	1	Ni	97.3	0.01	1.36	1.00	0.30
C(a)	2×10^{-4}	Ni	99.4	<0.01	0.27	0.06	0.28
C(b)	2×10^{-4}	Ni	99.5	<0.01	0.16	0.07	0.24



http://www.jaxa.jp/projects/rockets/h2b/index_j.html

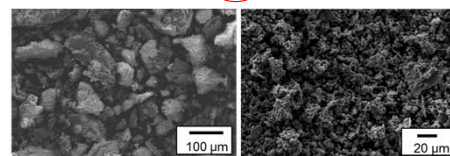
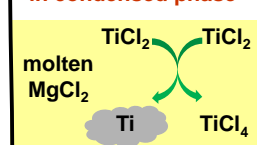


http://www.jfe-steel.co.jp/products/titanium/titan_yoto.html



<http://www.sumitomometals.co.jp/titanium/topics.html>

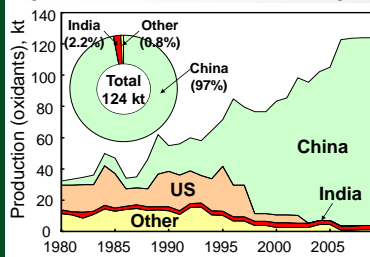
High-speed process in condensed phase



Exp. A 99.2%Ti
Exp. B 99.5%Ti
Ti with 99% purity was efficiently obtained using Ti vessel.

Environmentally Sound Technology for Recycling of Rare Metals

New Process for Recovery of REEs (Rare Earth Elements) from Magnet Scrap



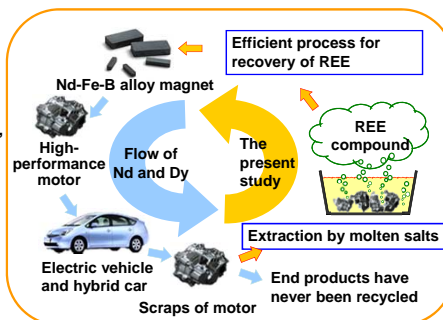
USGS Mineral Commodity Summaries (2010).

Export restriction on REEs by China in 2010 resulted in considerable material shortage in Japan.

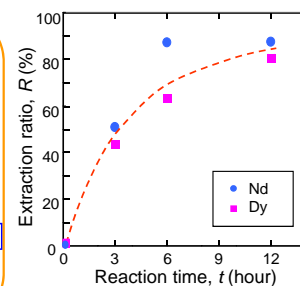
Insufficient "natural resources," but abundant "artificial resources."

Recycling and stockpiling of REEs are important.

Process for recovery of REE using molten salt



Extraction ratio of Nd, Dy by molten $MgCl_2$

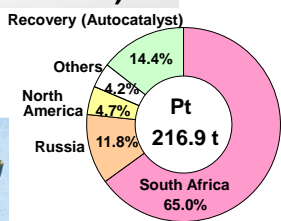


Over 80% of Nd, Dy was extracted.

Efficient Process for Recovery of PGMs (Platinum Group Metals)

Autocatalyst
Pt, Pd, Rh

Hard disk
Ru

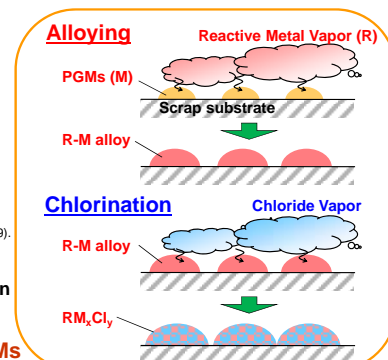


Jollie, D.: "Platinum 2009," Johnson Matthey Plc., UK (2009).

•Extreme localization of mines
•Extremely small volume of production

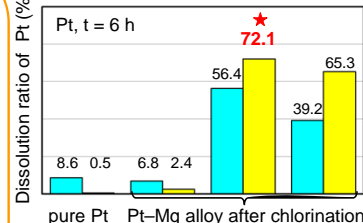
New process for recovery of PGMs

Process for recovery of PGMs using alloying and chlorination



Dissolution ratio of Pt after alloying and chlorination

T = 573 K 673 K 773K



Over 70% of Pt was dissolved in NaCl aq.