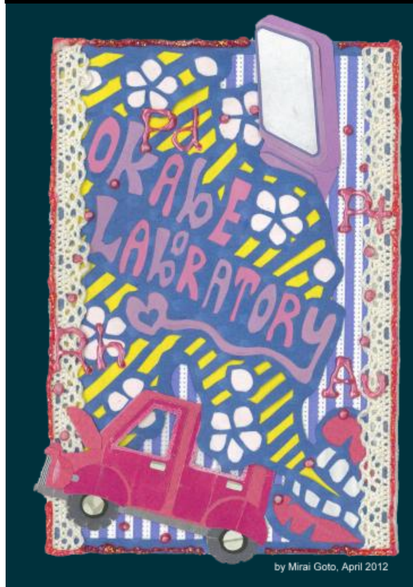


OKABE LAB.

[Future Materials : Titanium, Rare Metals]

International Research Center for Sustainable Materials

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

Let's touch the "Rare Metals".

IIS Open House in 2011

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

Department of Materials Engineering

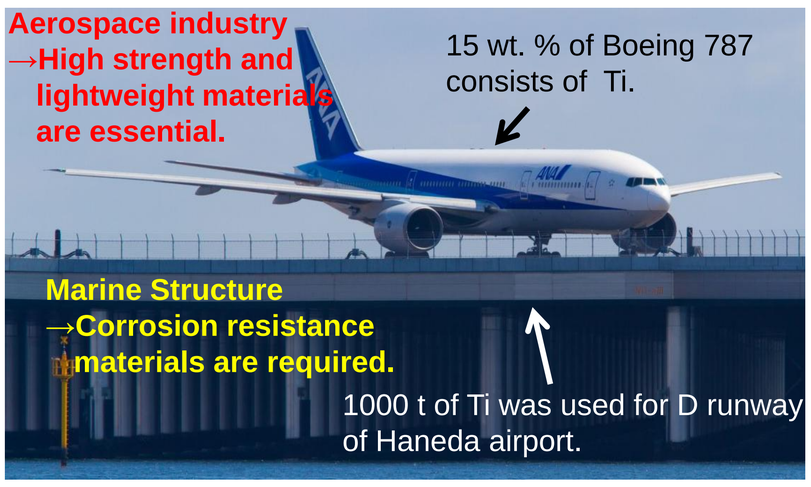
Changing Rare Metals into "Common" Metals !

Okabe lab. is focusing on research of new production processes for reactive metals and environmentally sound recycling technologies for rare metals, based on "Future Materials : Titanium, Rare Metals" as keyword.
We believe we can contribute to society by innovation of process technologies for rare metals.

New Production Process for Rare Metals

New Production Process for Titanium

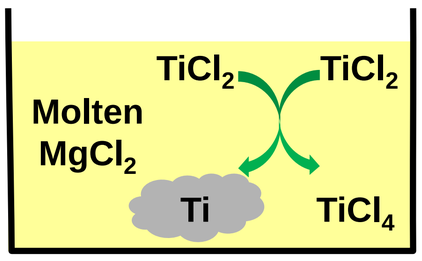
Ti has high strength to density ratio, corrosion resistance and abundant mineral resources, so "Base metal in the near future".



Ti production process using disproportional reaction of $TiCl_2$ in molten salt

Conventional process (Kroll process)
$TiCl_4 + 2Mg = Ti + 2MgCl_2$ + "Heat"

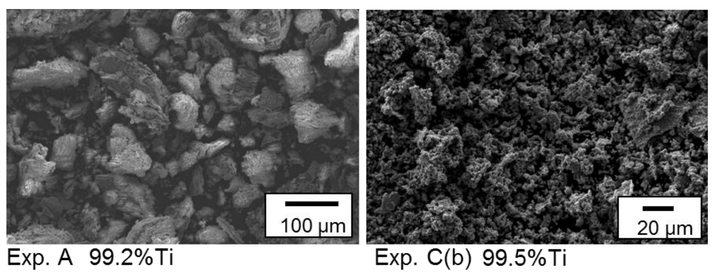
Disproportional reaction
$2TiCl_2 = Ti + TiCl_4$



High reaction rate in condensed phase

Analytical results of the obtained samples after leaching

Exp. No. (pos.)	Total pressure, p, (atm)	Crucible	Concentration of Ti sample, C_i (mass%) 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



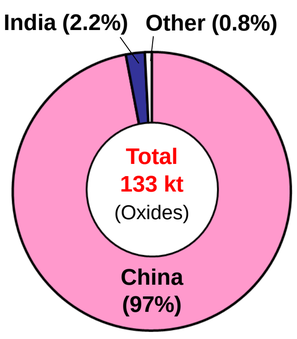
Exp. A 99.2%Ti Exp. C(b) 99.5%Ti

⇒Ti with a purity of 99.0 % was efficiently obtained.

Environmentally Sound Recycling Technology for Rare Metals

New recovery process for REEs (rare earth elements) from magnet scrap

Production amount of REE oxides in 2010



USGS Mineral Commodity Summaries (2011)

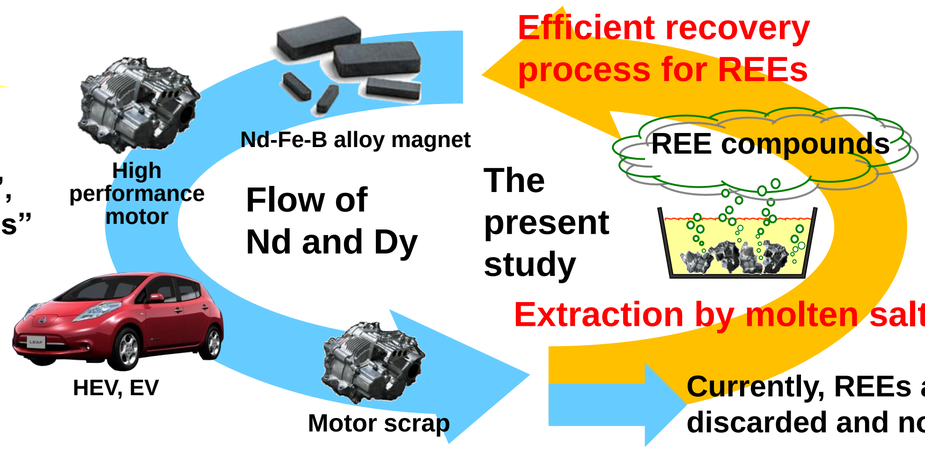
97% of REEs were produced in China.

Restriction on exports of REEs in 2010 by China.

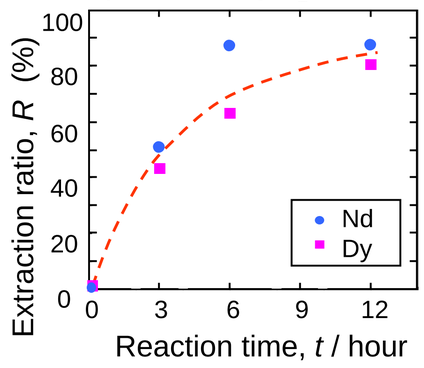
In Japan, little "natural mineral resources", but abundant "artificial resources" as commercial products.

Recycling and stockpile of REEs are important.

Recovery process for REEs using molten salt



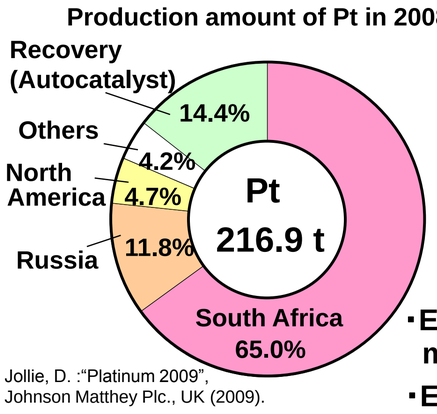
Extraction ratio of Nd, Dy by molten $MgCl_2$



⇒Over 80 % of Nd, Dy were extracted successfully.

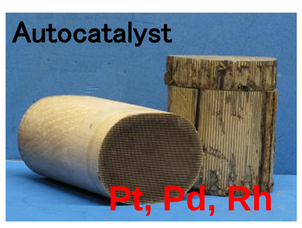
Efficient recovery process for PGMs (platinum group metals)

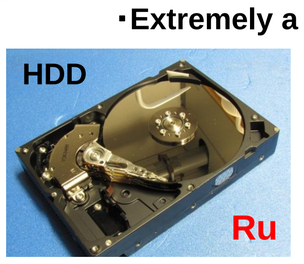
Production amount of Pt in 2008



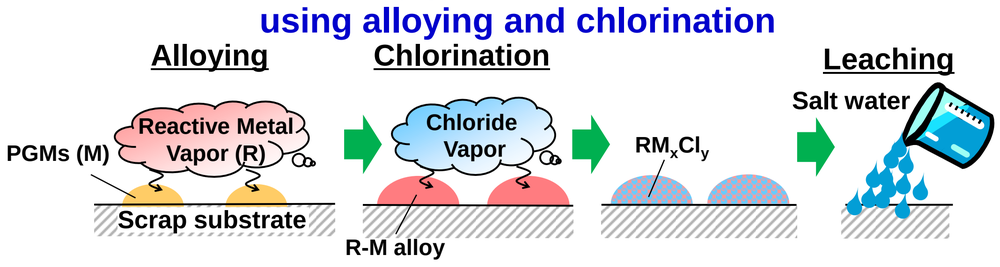
Jollie, D. :"Platinum 2009", Johnson Matthey Plc., UK (2009).

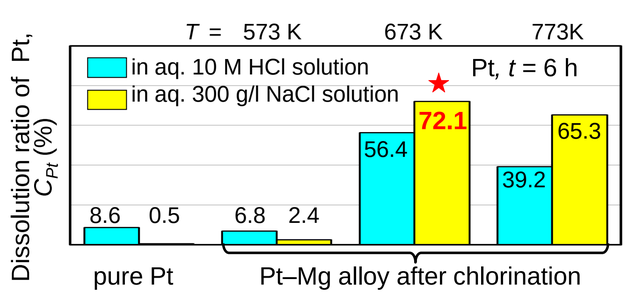
- **Extreme maldistribution of mines**
- **Extremely a little production**





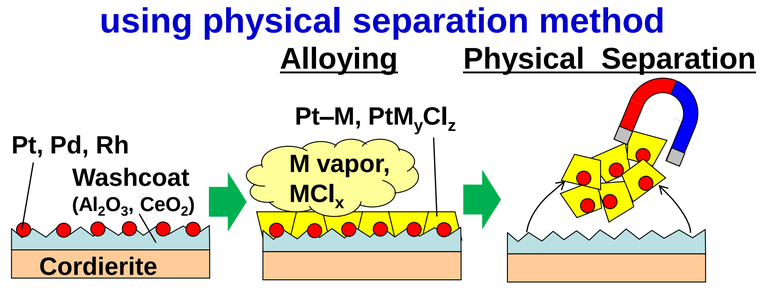
Recovery process for PGMs using alloying and chlorination

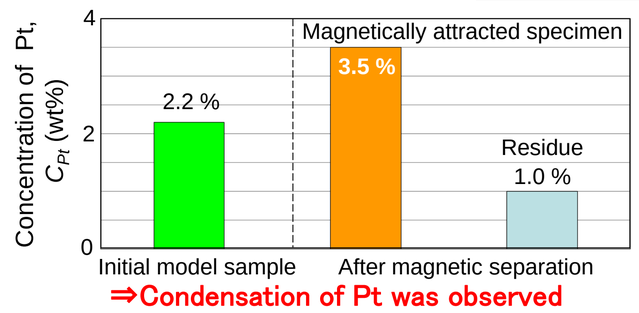




⇒Over 70 % of Pt was dissolved in NaCl aq.

Recovery process for PGMs using physical separation method





⇒Condensation of Pt was observed after magnetic separation.