IRCSM

OKABE LAB.

[Future Materials : Titanium, Rare Metals]

International Research Center for Sustainable Materials
http://okabe.iis.u-tokyo.ac.jp
Rare-Metal Process Engineering
Department of Materials Engineering

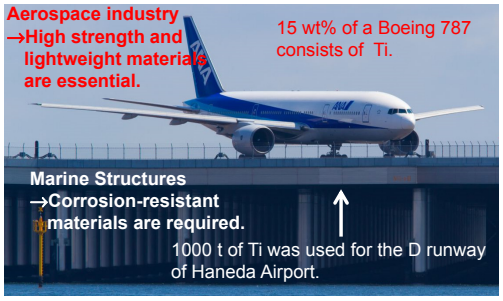
Changing Rare Metals into "Common" Metals !

Okabe Lab. is focusing on research into new production processes for reactive metals and environmentally sound recycling technologies for rare metals, based on "Future Materials : Titanium, Rare Metals" as the keywords. We believe we can contribute to society by developing innovative process technologies for rare metals.

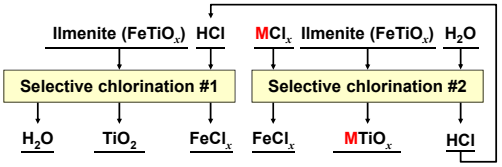
New Production Process for Rare Metals

New Production Process for Titanium

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



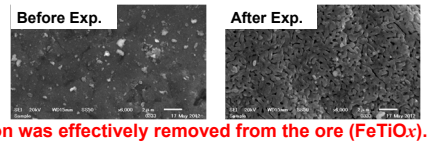
Upgrading of titanium ore through selective chlorination using metal chlorides



[Chlorination #1]
$FeO(s) + 2\,HCl(g) = FeCl_2(l,g) + H_2O(g)$

[Chlorination #2]
$FeO(s) + TiO_2(s) + MCl_2(l) = FeCl_2(l,g) + MTiO_3(s)$

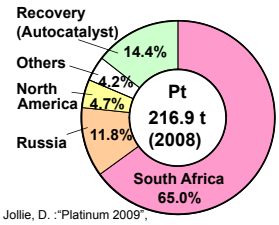
Metal chloride, MCl_x	Atmosphere	Concentration of element i, C_i (mass%) Feedstock Ti	Feedstock Fe	After reaction #1 Ti	After reaction #1 Fe
$CaCl_2$	Ar	45.0	49.7	96.7	0.2
$MgCl_2$	Ar	45.0	49.7	96.7	1.8
$MgCl_2$	Ar + H_2O	45.0	49.7	97.2	1.2



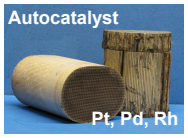
⇒ Iron was effectively removed from the ore ($FeTiO_x$).
(TiO_2: 51% → about 97%)

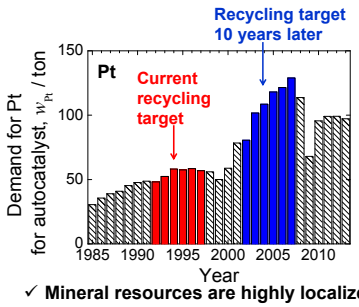
Environmentally Sound Recycling Technology for Rare Metals

Efficient Recovery Process for Platinum Group Metals (PGMs)



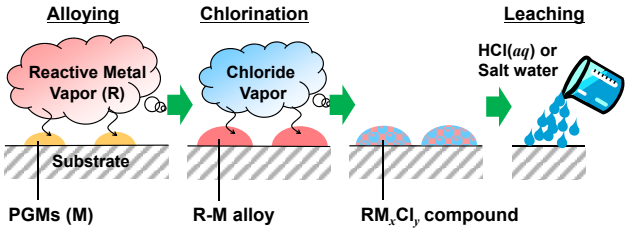
Jollie, D. :"Platinum 2009", Johnson Matthey Plc., UK (2009).

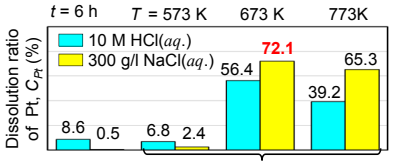




- ✓ Mineral resources are highly localized.
- ✓ Production volume is very small.
- ✓ Amount of PGMs recovered from scrap will increase markedly in the future.

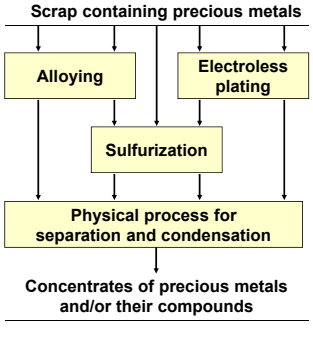
Dissolution process for PGMs using alloying and chlorination

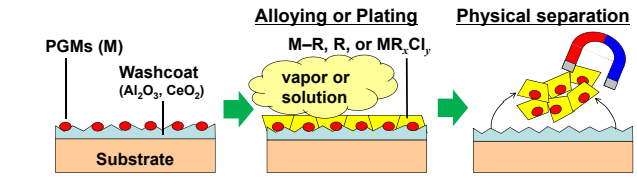




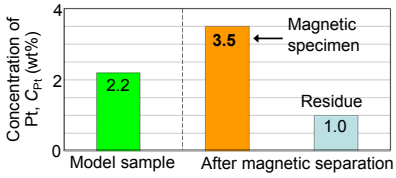
⇒Over 70% of Pt was dissolved in NaCl aq.

Condensation process for PGMs using physical separation technique

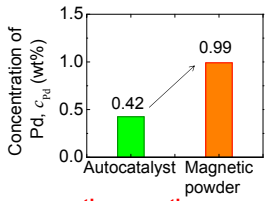




e.g.) *Alloying by $FeCl_3$ vapor + Magnetic separation*



e.g.) *Electroless Ni plating + Magnetic separation*



⇒PGMs were concentrated after magnetic separation.