

OKABE LAB.

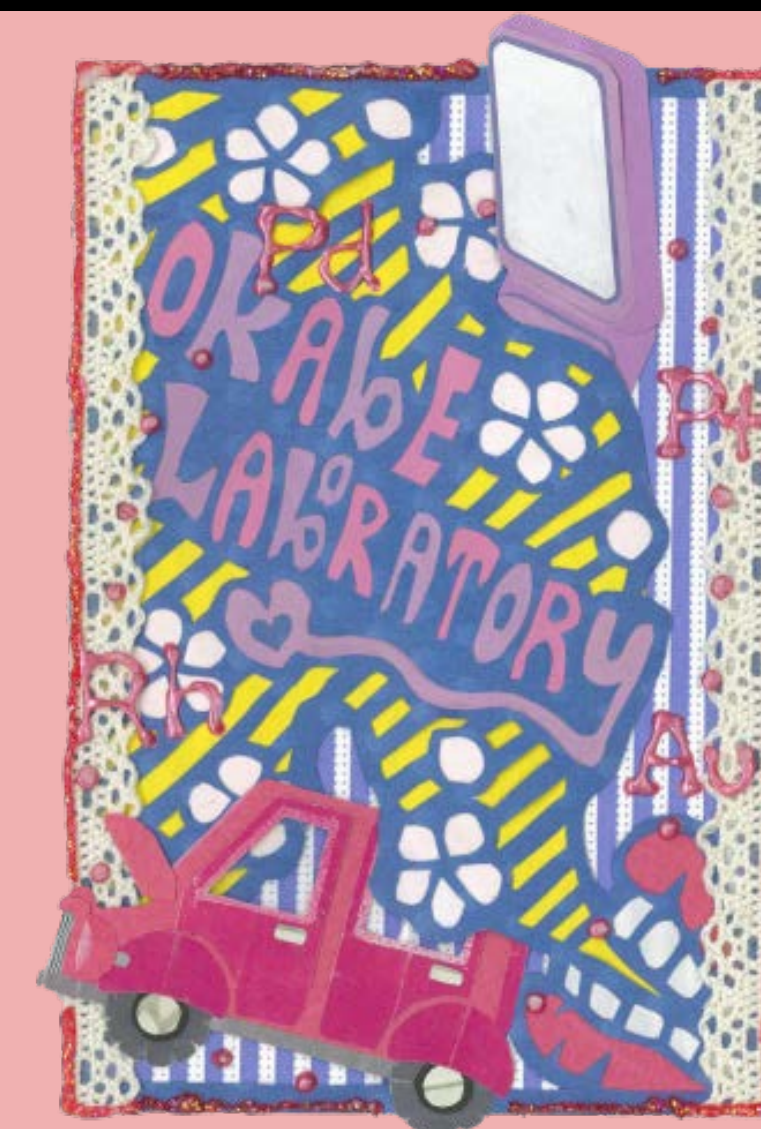
[Future Materials : Titanium, Rare Metals]

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 !

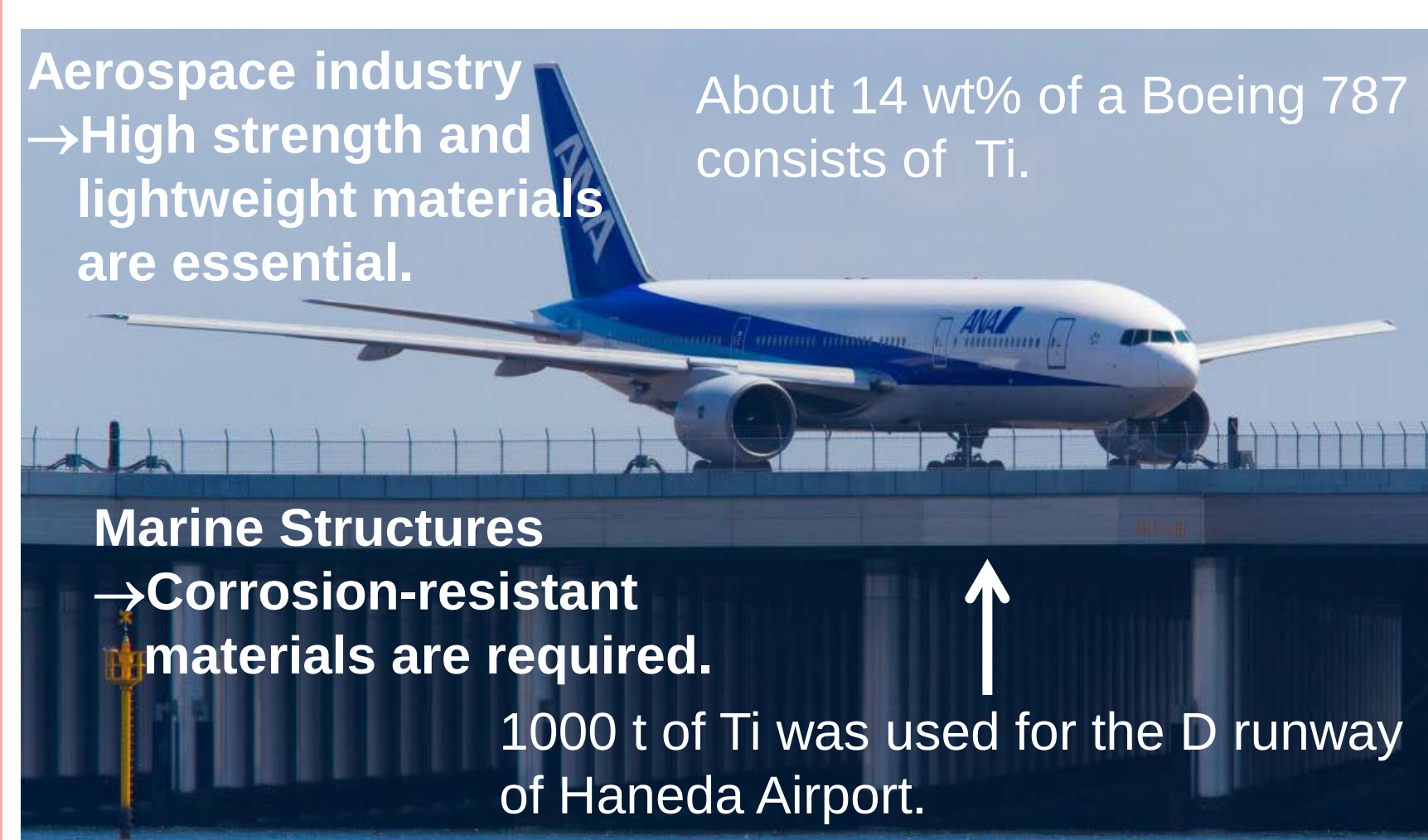
Okabe Lab. is focusing on research into new production processes for reactive metals and environmentally sound recycling technologies for rare metals, based on “Future Materials : Titanium, Rare Metals” as the keywords.

We believe we can contribute to society by developing innovative process technologies for rare metals.

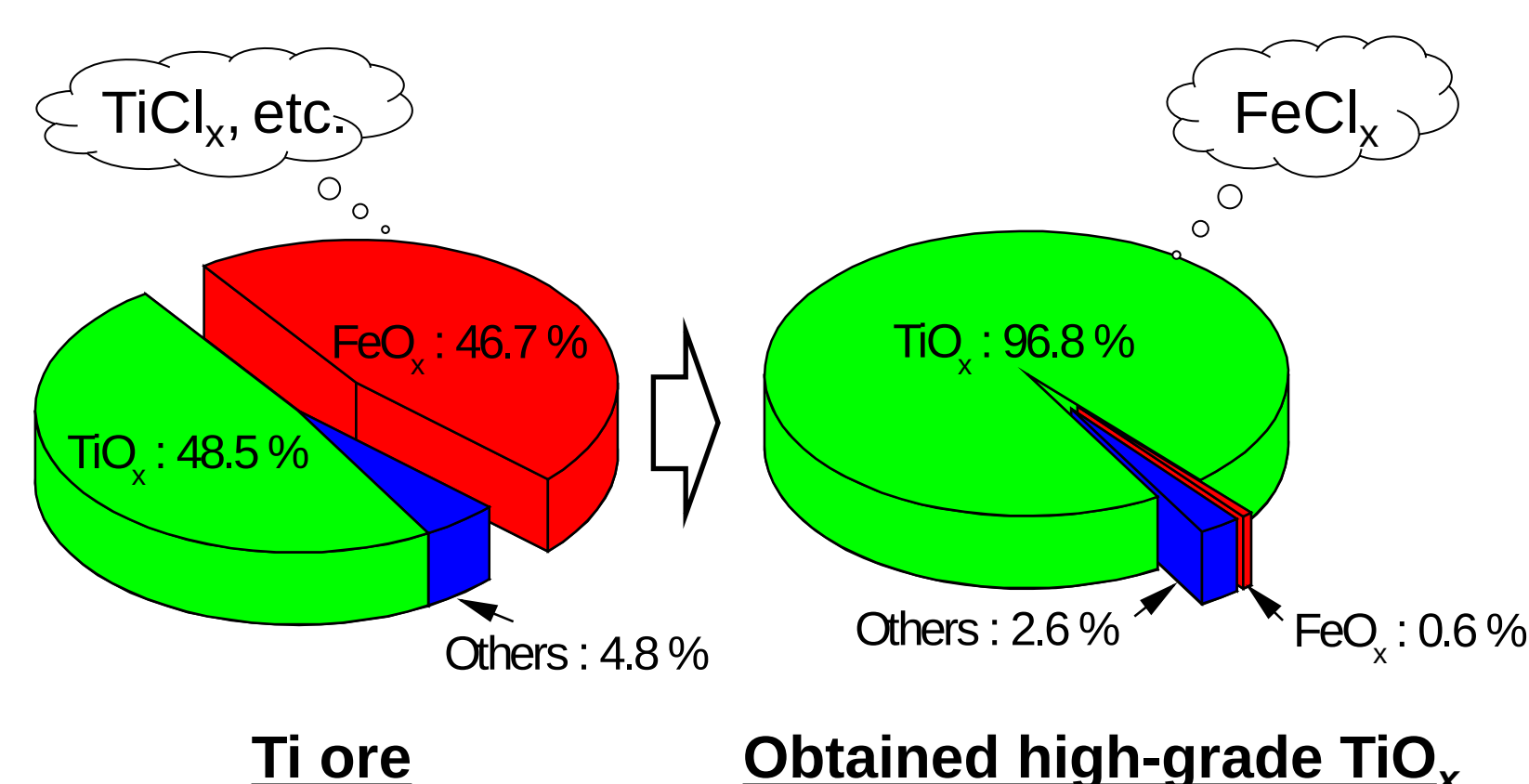
New Production & Recycling Process for Titanium

Titanium (Ti):

Excellent mechanical property
High corrosion resistance
Abundant mineral resource



Upgrading of Ti ores through selective chlorination



Iron was effectively removed from ilmenite (FeTiO_x) and highly-pure TiO_2 was obtained through selective chlorination using metal chlorides such as TiCl_4 .

Recycling technologies for low-grade Ti metal scraps utilizing molten-salt-based reactions



Aviation parts made of Ti alloys are usually fabricated with a material loss that is often 80-90%.

O and Fe removal is very difficult.

“Reaction-mediator-bases chlorination”

TiCl_4 was effectively recovered by combining Ti scrap and chloride waste.

“Electrochemical deoxidation”

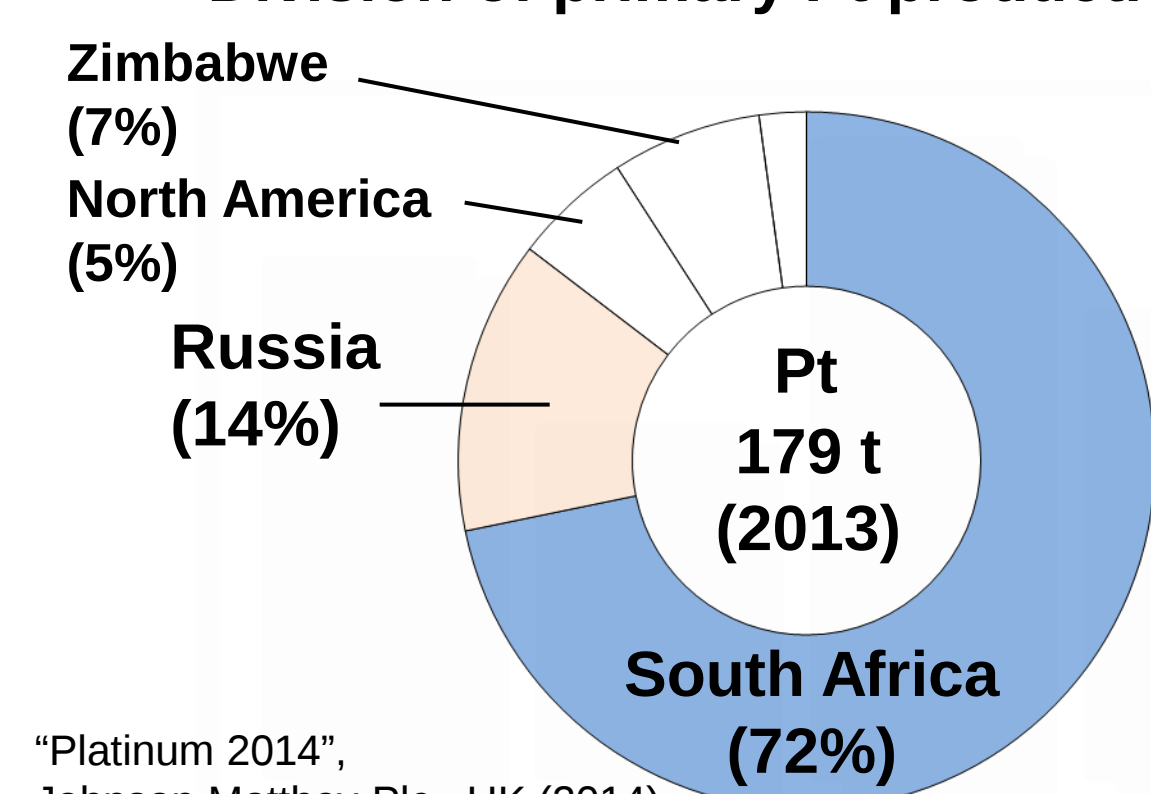
Oxygen dissolved in scrap was removed by electrolysis in MgCl_2 .

Environmentally Sound Recycling Technology for Rare Metals

Platinum Group Metals (PGMs):

Expensive
Essential for automobile

Division of primary Pt production



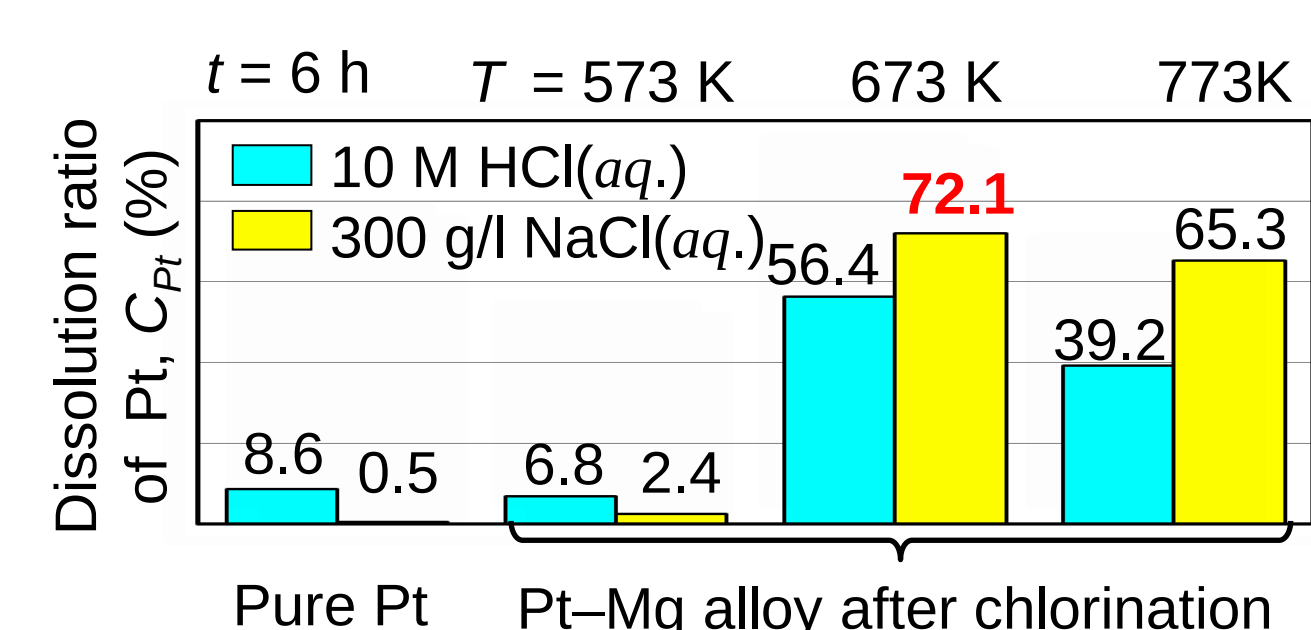
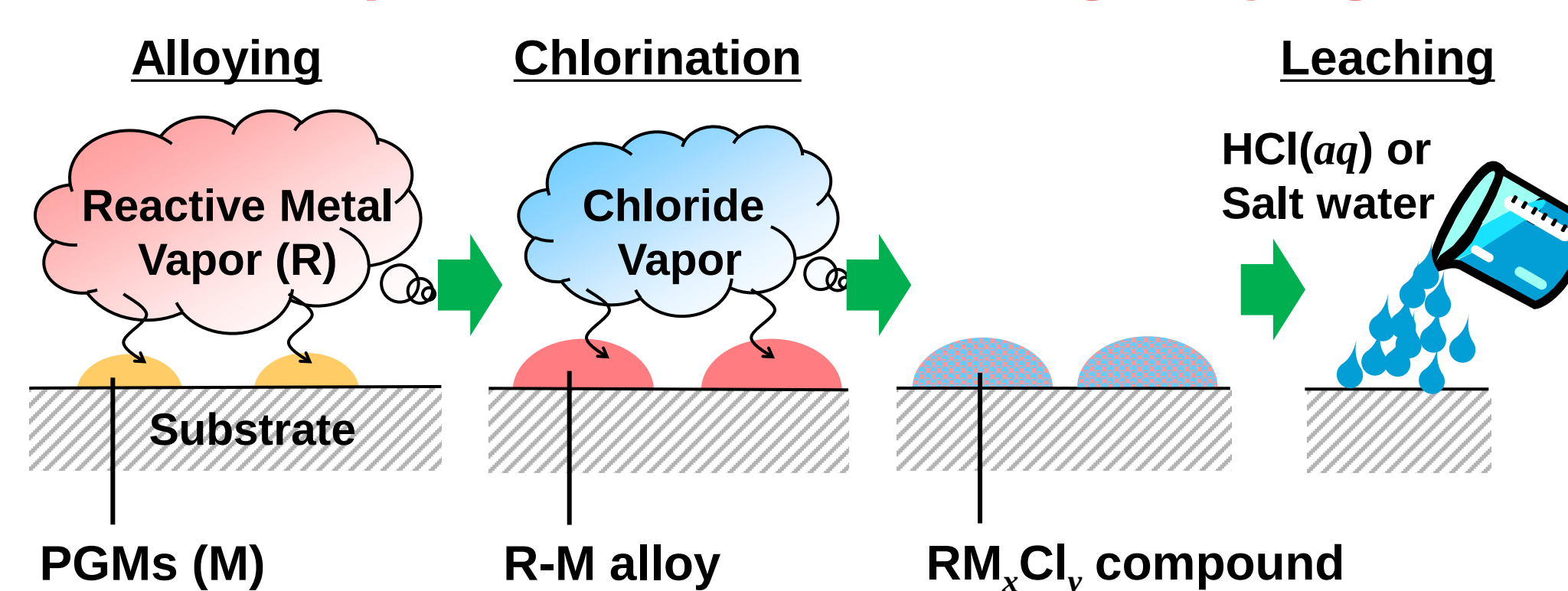
“Platinum 2014”,
Johnson Matthey Plc., UK (2014).

Autocatalyst



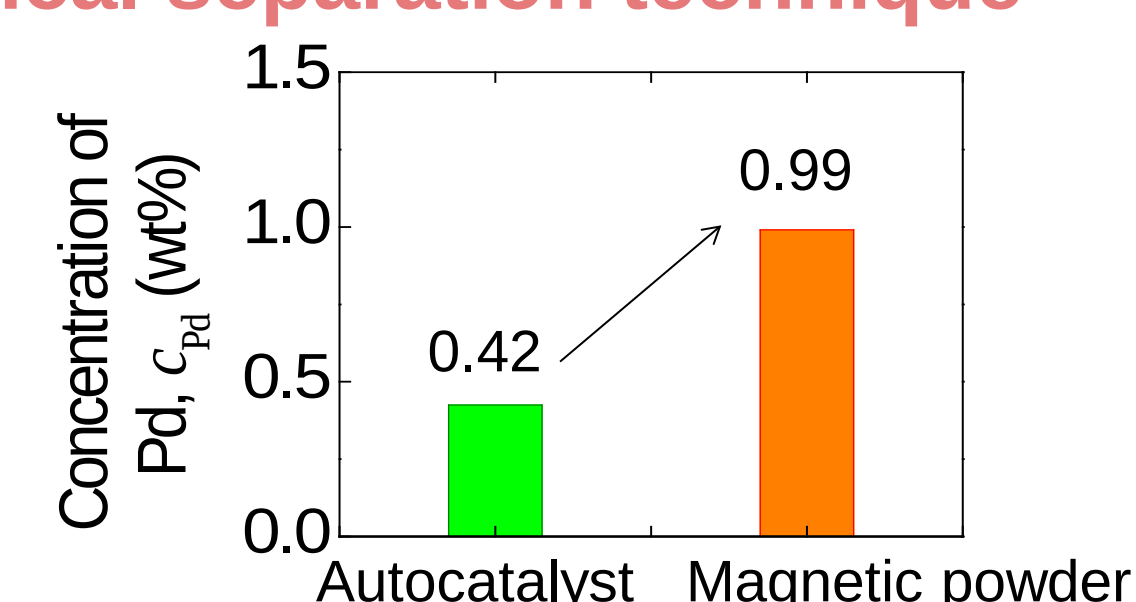
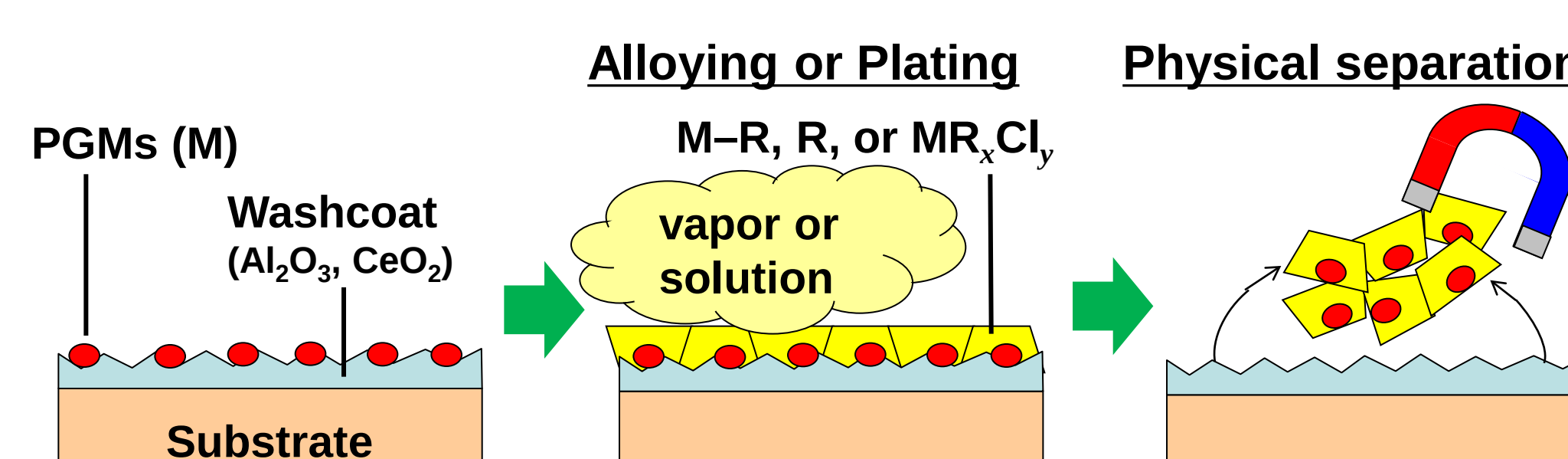
Major demand for
Platinum (Pt),
Palladium (Pd),
Rhodium (Rh).

Dissolution process for PGMs using alloying and chlorination



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

Condensation process for PGMs in scraps utilizing physical separation technique



⇒ PGMs were concentrated by magnetic separation after Ni plating.

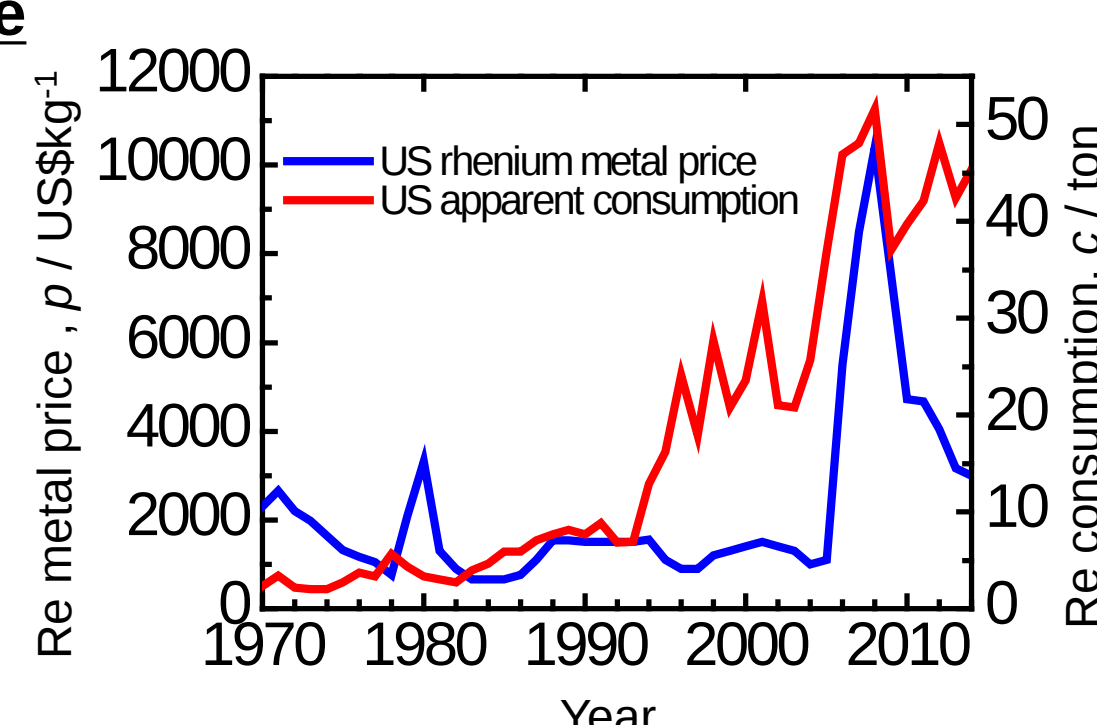
Refractory metals such as Tungsten (W) and Rhenium (Re)

Main W application:
Cemented carbide tools

Supply of W resource is highly localized in China just like rare earth elements.

Main Re application: Turbine blade
Re-added Ni based superalloy is used

[ref] Honda Motor Co., Ltd. webpage



Environmentally sound recycling without toxic waste generation has been investigated.

- Metal extraction using low-melting metal as a collector
- Separation and refining of rare metals based on chloride volatilization