# T. OKABE LAB.

## Future Materials: Titanium, Rare Metals

Research Center for Sustainable Material Energy Integration

Resource Recovery and Materials Process Engineering
Department of Materials Engineering, Graduate School of Engineering
http://www.okabe.iis.u-tokyo.ac.jp/

# Turning rare metals into “common metals”!!

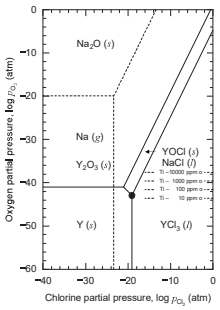
Okabe Laboratory is working on the research and development of new smelting processes and environmentally friendly recycling processes for rare metals. Our main focus is "future materials: titanium and rare metals”. We aim to innovate rare metal process technology for the betterment of society.

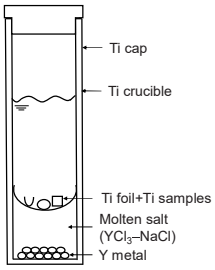
## ■ Upgrade recycling of Ti


Ti ingot → Fabrication → Ti product → **Ti scrap such as turning**


Titanium (Ti) scrap generated in the Ti ingot fabrication process is contaminated by oxygen impurities. Therefore, it is difficult to recycle Ti scraps into ingots.

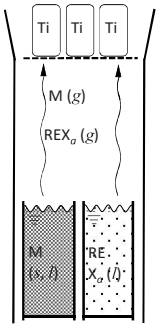
### ➢ Deoxidation of Ti using rare earth metals

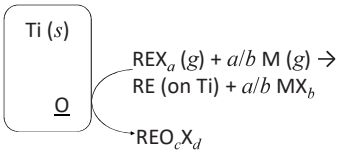



Based on thermodynamic calculations, we have developed a novel deoxidation technology of directly removing oxygen from Ti scrap using rare earth metals such as yttrium (Y) and cerium (Ce).

### ➢ Deoxidation of Ti via gas phase




RE = Y, La, Ce, Ho...
X = F, Cl, Br, I...
M = Sm, Eu, Tm, Yb,
Li, Na, K, Ca...

We have developed a novel deoxidation technology for reducing the amount of deposits on Ti surface and impurities in Ti by supplying deoxidants and fluxes to Ti through the gas phase.

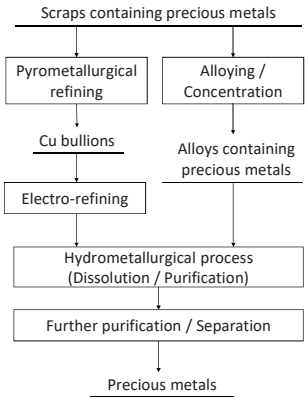
## ■ Recycling of precious metals

**Automotive catalyst**
- Platinum (Pt)
- Palladium (Pd)
- Rhodium (Rh)

**Electronics**

PCBs
- Gold (Au)

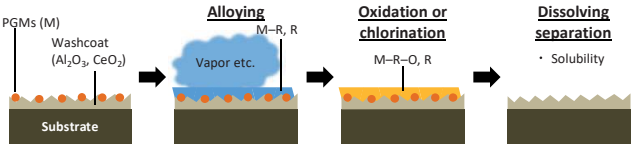
Automotive catalysts contain 100–1000 times more PGMs than PGM ore. PCBs contain around 10 times more Au than Au ore.




To dissolve precious metals into solution, the process
- × requires strong chemicals
- × generates a large amount of hazardous liquid waste
- × consists of multiple steps

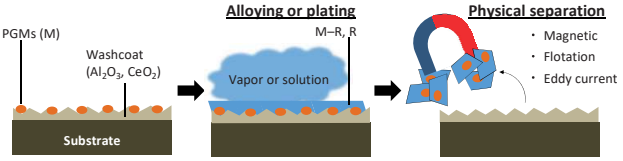
★ Environmental-friendly and highly efficient process is required.

### ➢ Solubilization process




Technology to dissolve precious metals in non-oxidizing acids (e.g., hydrochloric acid) and solutions (e.g., sea water) using a pretreatment of alloying them with reactive metals such as magnesium (Mg) or calcium (Ca) followed by oxidation or chlorination.

### ➢ Physical concentration process




Technology to selectively add functions (e.g., magnetism, hydrophobicity) to areas of scrap containing precious metals by electroless plating or chemical treatment with chloride or sulfide vapors, allowing for the concentration of precious metals using physical separation.