RCSMEI

OKABE LAB.

[Future Materials: Titanium, Rare Metals]

Research Center for Sustainable Material Energy Integration

Resource Recovery and Materials Process Engineering

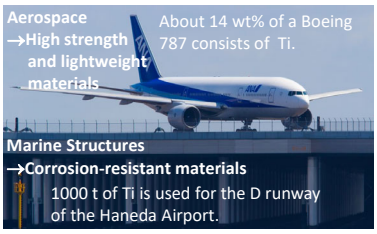
Department of Materials Engineering

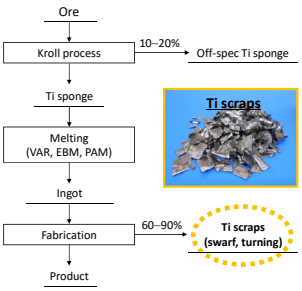
http://okabe.iis.u-tokyo.ac.jp

Changing Rare Metals to "Common" Metals!

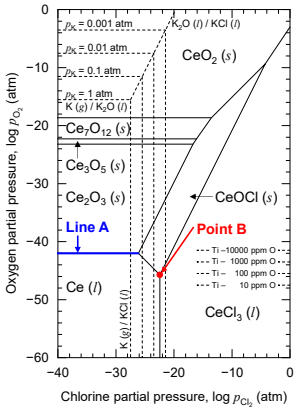
Okabe Laboratory focuses on the research of new production processes for reactive metals and environmentally friendly recycling technologies for rare metals, based on the key words "Future Materials : Titanium, Rare Metals." We aim to contribute to the society by developing innovative process technologies for rare metals.

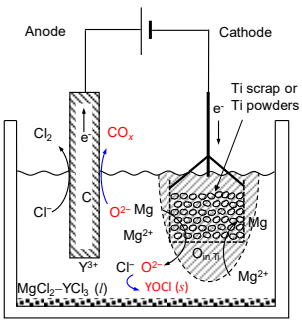
Upgrade Recycling of Ti





Ti scraps generated through fabrication process are heavily contaminated by oxygen, which makes it difficult to recycle scraps into ingots.





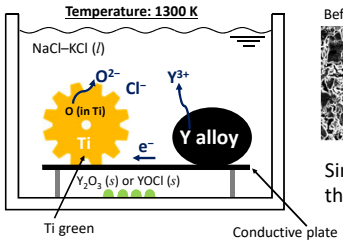
Cathode : $O\ (\text{in Ti}) + 2\ e^- = O^{2-}$

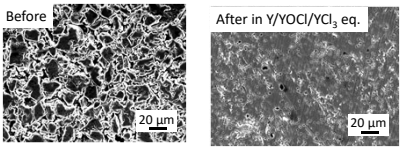
$O^{2-} + Y^{3+} + Cl^- = YOCl\ (s) \downarrow$

Anode : $O^{2-} + 1/x\ C\ (s) = 1/x\ CO_x\ (g) \uparrow + 2\ e^-$

Novel processes using rare earth elements such as yttrium (Y) and cerium (Ce) can effectively remove oxygen from Ti scraps and upgrade it to Ti with higher purity compared to primary products from ores (Ti sponge).

New Ti Sintering Process

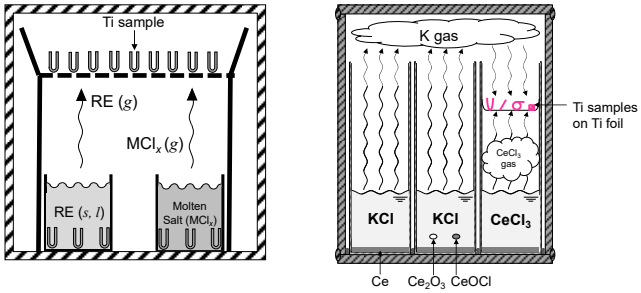




Sintering reaction of Ti powder occurred in the ultra-low-oxygen potential.

Using this process, desired low-O-concentration Ti products can be manufactured from inexpensive and high-O-concentration Ti powder.

Deoxidation of Ti via Gas Phase



New deoxidation processes that supply rare earth (RE) metals with high vapor pressures and chlorides (MCl_x) to Ti via a gas phase were devised and demonstrated.

Recycling of Precious Metals

Platinum group metals (PGMs)

Autocatalyst

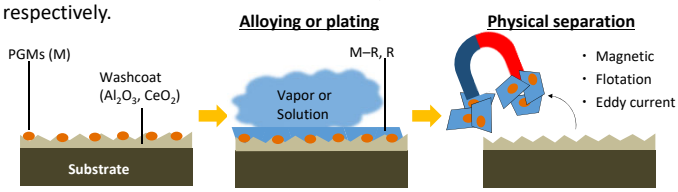
Major usage of Platinum (Pt), Palladium (Pd), Rhodium (Rh).

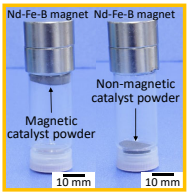
Gold (Au)

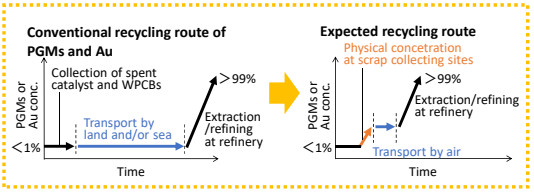
Printed circuit boards (PCBs)

Au accounts for 60% of intrinsic value of all metals in PCBs.

The concentrations of PGMs in spent autocatalysts and of Au in waste PCBs (WPCBs) are 1000 and 10 times higher than that in natural ores, respectively.







New processes to concentrate precious metals from scraps utilizing electroless plating or $FeCl_2$ vapor treatment followed by magnetic separation were developed. The concentrated scraps can be transported to refineries by air, which ensures reduction in transport time and cost compared to conventional transportation by land and/or sea. These new processes are expected to establish a new business scheme wherein scraps are collected and processed in Japan.