IRCSEM

OKABE LAB.

[Future Materials: Titanium, Rare Metals]

Integrated Research Center for Sustainable Energy and Materials

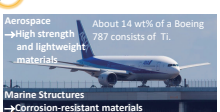
Resource Recovery and Materials Process Engineering

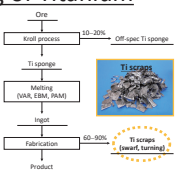
Department of Materials Engineering http://okabe.iis.u-tokyo.ac.jp

Changing Rare Metals to "Common" Metals!

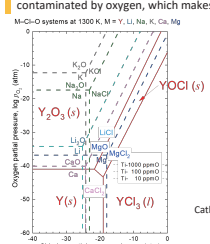
Okabe Laboratory is focusing on the research of new production processes for reactive metals and environment-friendly recycling technologies for rare metals, based on the keywords "Future Materials : Titanium, Rare Metals". We believe that we can contribute to the society by developing innovative process technologies for rare metals.

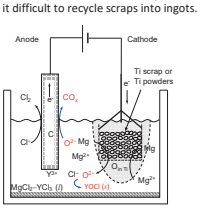
Upgrade Recycling of Titanium





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





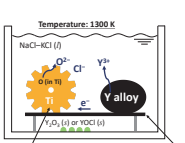
Cathode : $O\ (in\ Ti) + 2\,e^- = O^{2-}$

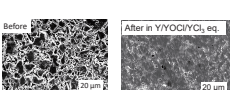
$O^{2-} + Y^{3+} + Cl^- = YOCl\ (s) \downarrow$

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 holmium (Ho) can effectively remove oxygen from Ti scraps and upgrade it to Ti with higher purity compared to primary products from ores.

New Ti Sintering Process





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

By developing this process, inexpensive high-O-concentration Ti powder can be applied for fabricating the desired low-O-concentration Ti products.

Recycling of Precious Metals

Platinum group metals (PGMs)

Autocatalyst

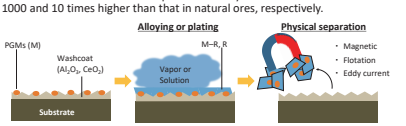
Major demand for Platinum (Pt), Palladium (Pd), Rhodium (Rh).

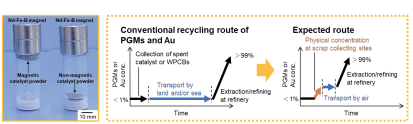
Gold (Au)

Printed circuit boards (PCBs)

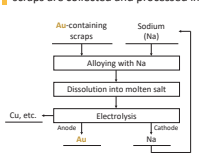
Au accounts for 60% of intrinsic value of all metals contained.

The concentration of PGMs in spent autocatalysts and of Au in WPCBs are 1000 and 10 times higher than that in natural ores, respectively.

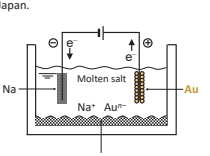




New processes to concentrate precious metals from scraps utilizing electroless plating or $FeCl_2$ vapor treatment followed by magnetic separation were developed. The concentrated scraps can be transported to refineries by air, which ensures reduction in transport time and cost compared to conventional 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.



☆ No consumption of Na
☆ No exhaust gas
☆ No liquid waste



Cathode : $n\,Na^+ + n\,e^- = n\,Na$

Anode : $Au^{n-} = Au + n\,e^-$

Au alloyed with reactive metals such as Na dissolves into molten salt as anions. "Anodic deposition" through the anion dissolution and molten salt electrolysis can selectively separate and recover Au from scraps.