IRCSEM

OKABE LAB.

[Future Materials: Titanium, Rare Metals]

Integrated Research Center for Sustainable Energy and Materials

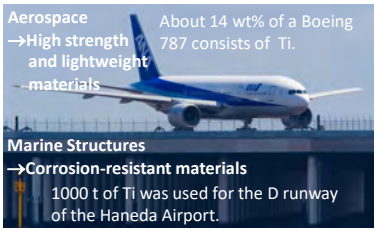
Resource Recovery and Materials Process Engineering

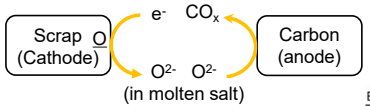
Department of Materials Engineering http://okabe.iis.u-tokyo.ac.jp

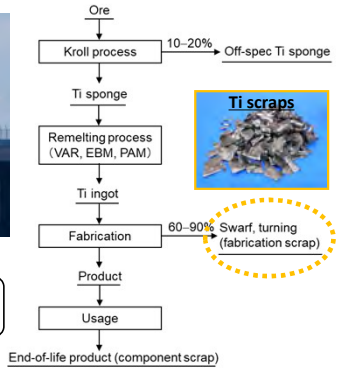
Changing Rare Metals to "Common" Metals!

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

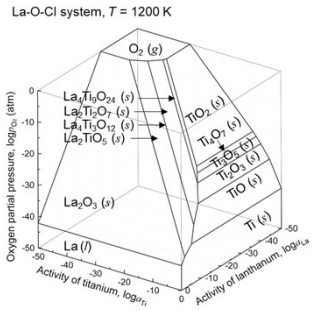
Smelting and Refining of Ti

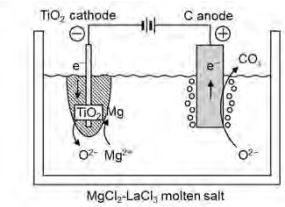






New recycling processes that can remove oxygen in Ti scraps utilizing thermochemical and electrochemical techniques were developed.





Anode: $C(s) + x\,O^{2-}$ (in salt) $= CO_x(g) + 2x\,e^-$

Cathode: $x\,Mg^{2+}$ (in salt) $+ 2x\,e^- = x\,Mg(l)$

$TiO_2(s) + 2\,Mg(l) = Ti(s) + 2\,MgO(s)$

$MgO(s) + LaCl_3(l) = MgCl_2(l) + LaOCl$ (in salt)

New smelting processes to obtain Ti from TiO_2 using rare earth elements were designed through thermodynamic consideration. These processes ensure economical rationality and environmental harmony.

Recycling of Precious Metals

Platinum group metals (PGMs)

Autocatalyst

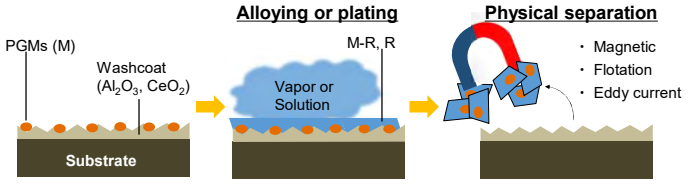
Major demand for Platinum (Pt), Palladium (Pd), Rhodium (Rh).

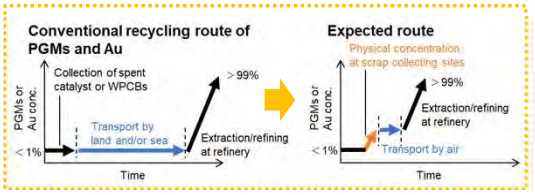
Gold (Au)

Printed circuit boards (PCBs)

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

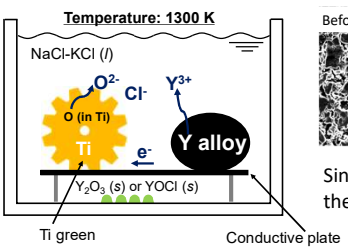
The concentration of PGMs in spent autocatalysts and of Au in WPCBs are 1000 and 10 times higher than that in natural ores, respectively.

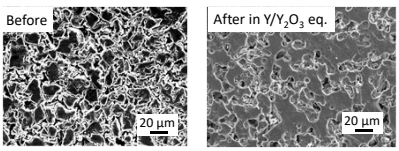




New processes to concentrate precious metals from scraps utilizing electroless plating or $FeCl_2$ vapor treatment followed by magnetic separation were developed. The concentrated scraps can be transported to refineries by air, which ensures reduction in transport time and cost compared to conventional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

New Ti Sintering Process





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

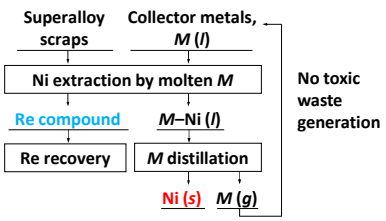
By developing this process, inexpensive high-O-concentration Ti powder can be applied for fabricating the desired low-O-concentration Ti products.

Recycling of Re from Superalloy

Main Re application : Turbine blade

Re-added Ni-based superalloy is used

Re is one of the rarest elements in the world



Environment-friendly recycling processes without toxic waste generation have been demonstrated in our lab.