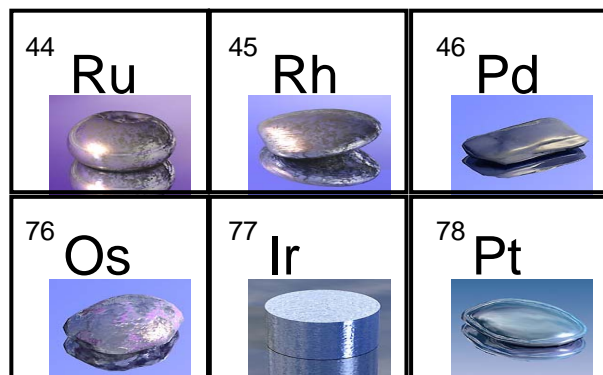

New Separation and Recovery Process of Platinum using Chlorinating Agents

Chiyoko Horike and Toru H. Okabe

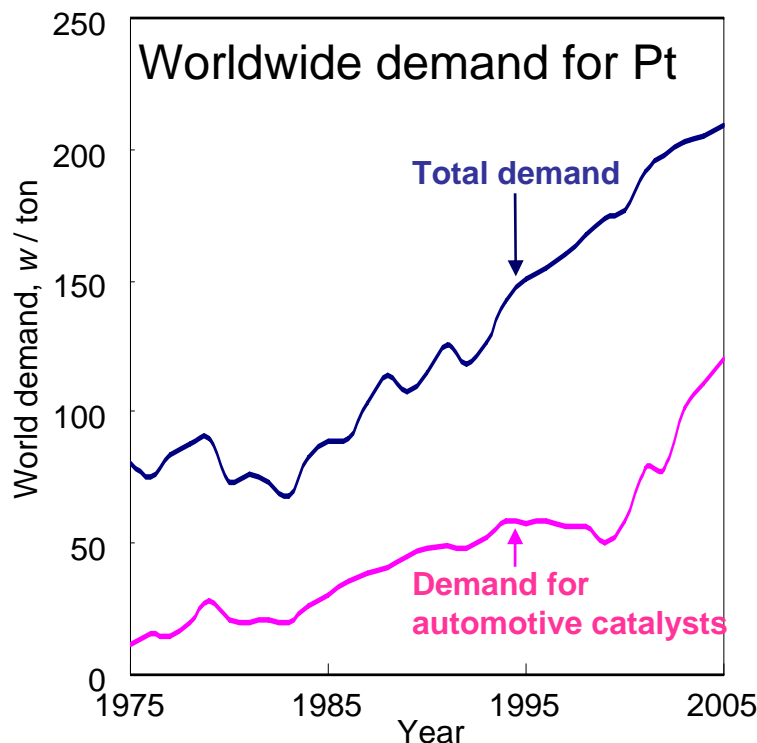
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Platinum group metals (PGMs)

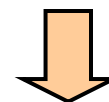


Characteristics

- High electric conductivity
- Corrosion resistance
- Heat resistance
- Catalytic properties



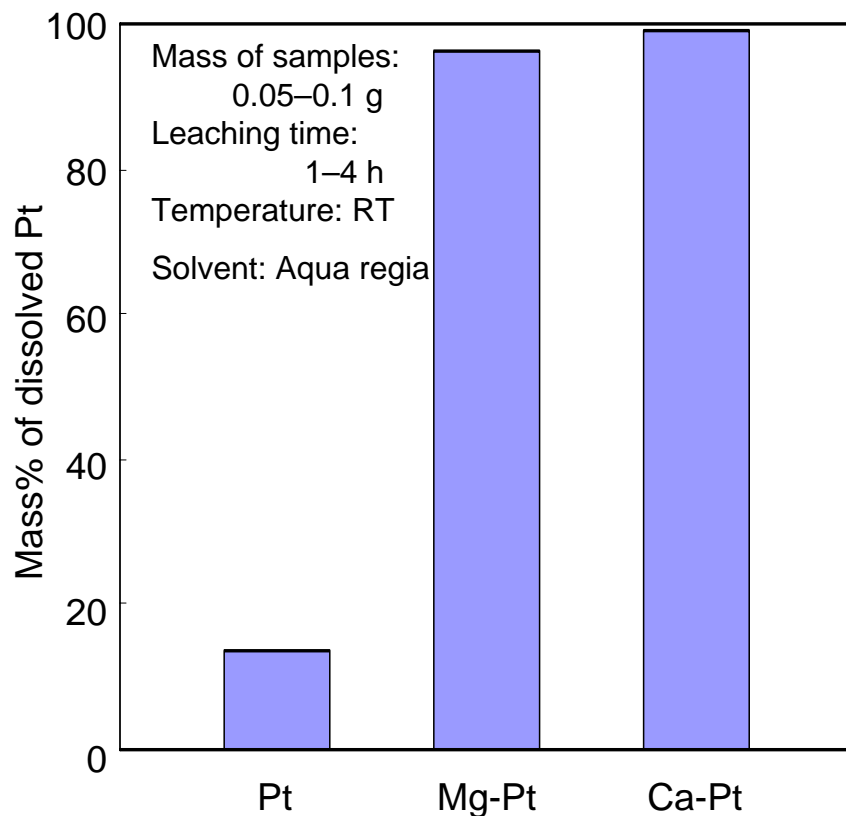
The worldwide demand for Pt is increasing.



The development of an efficient recovery process of Pt is very important.

Previous research conducted by our group

New extraction process of PGMs from waste materials by using reactive metal vapor

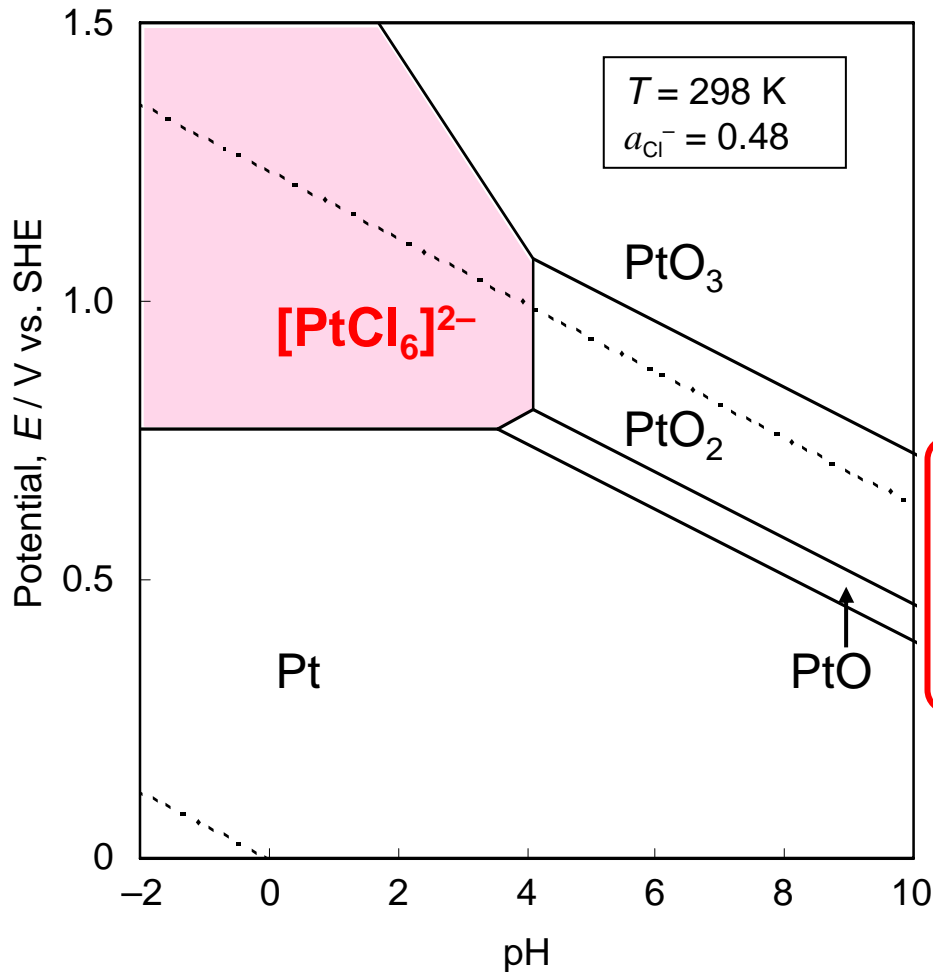


Alloying treatment of PGMs using reactive metals vapor



The dissolution efficiency of PGMs in aqua regia improved significantly.

Pourbaix diagram for Pt-H₂O-Cl system



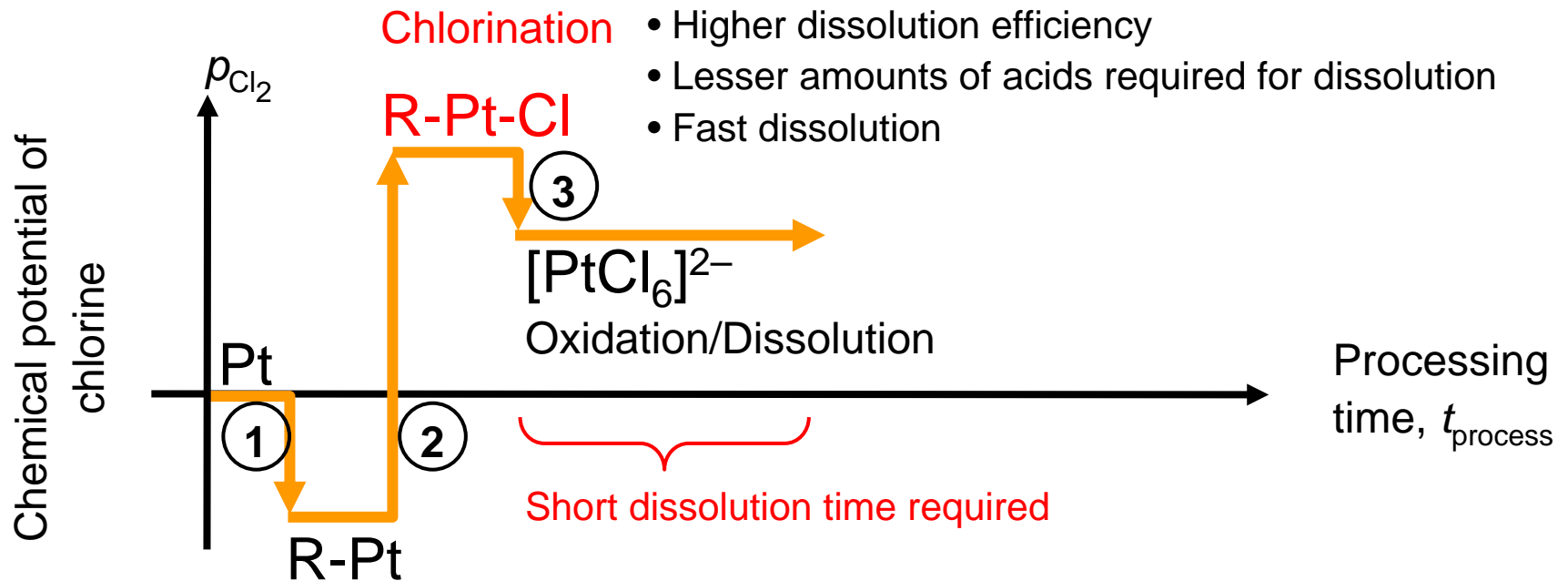
Pt is dissolved in 1M HCl to form a chloro complex in the +4 oxidation state.



The chlorination of Pt is an effective pretreatment for dissolution.

Purpose of this study

Development of a new process for the effective recovery of PGMs from scrap

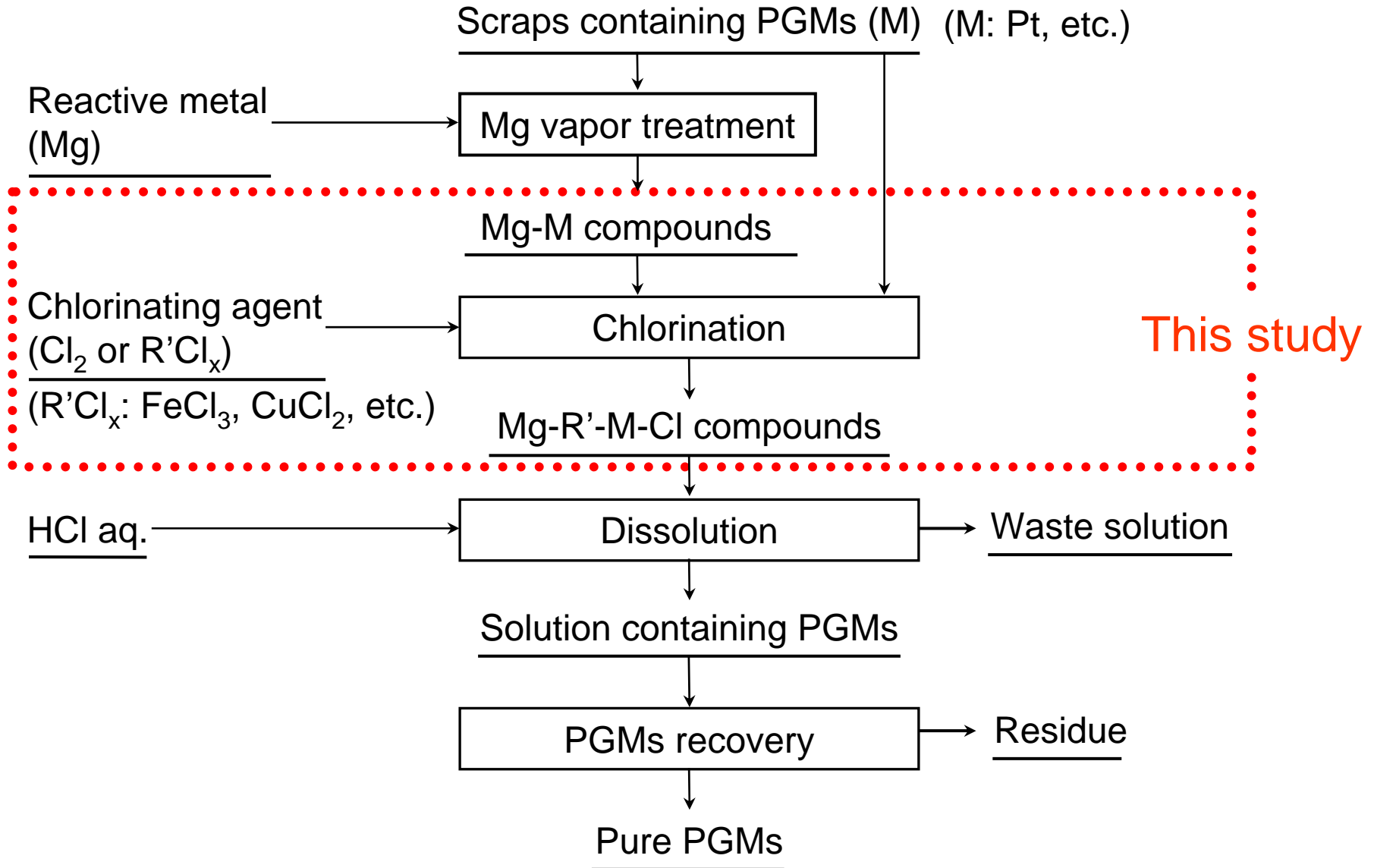


R: reactive metal

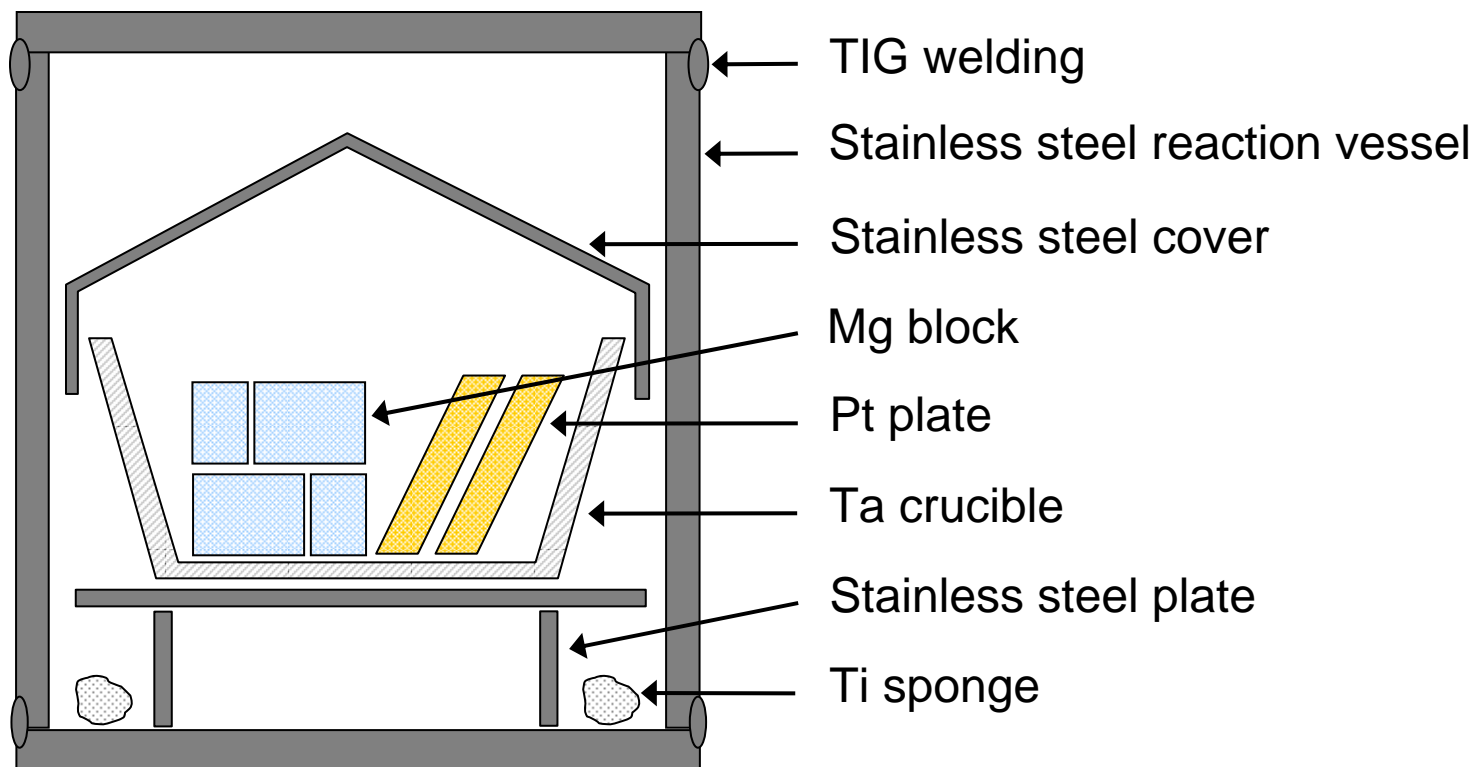
Compound formation under a highly reducing atmosphere

- Pretreatment for selective and efficient dissolution of PGMs

Flowchart of the new process

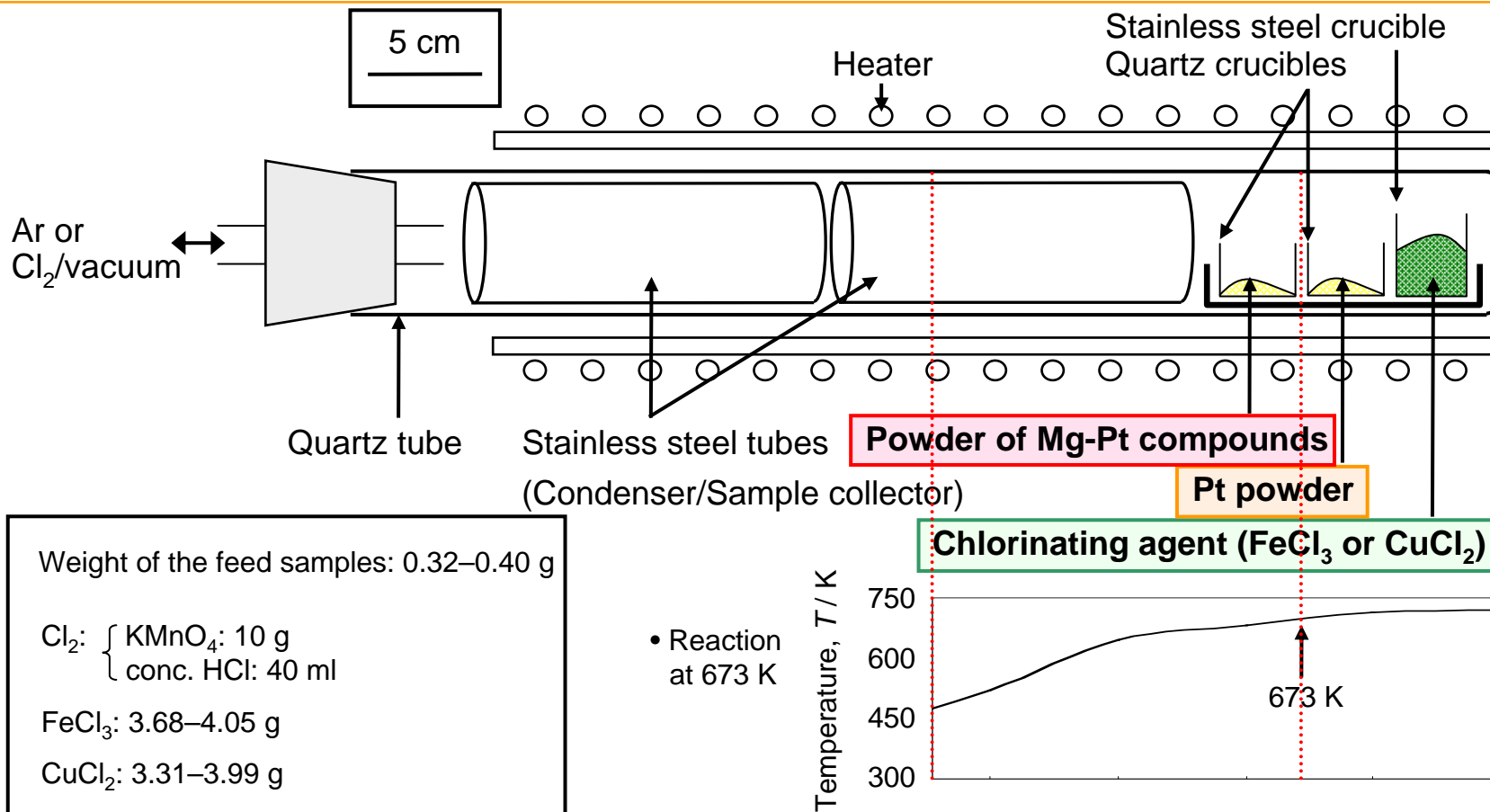


Synthesis of Mg-Pt compounds



Pure Pt was reacted with molten Mg at 1173 K for 12 h.
→ Homogeneous Mg-Pt compounds were formed.
(SEM, EDS, XRD)

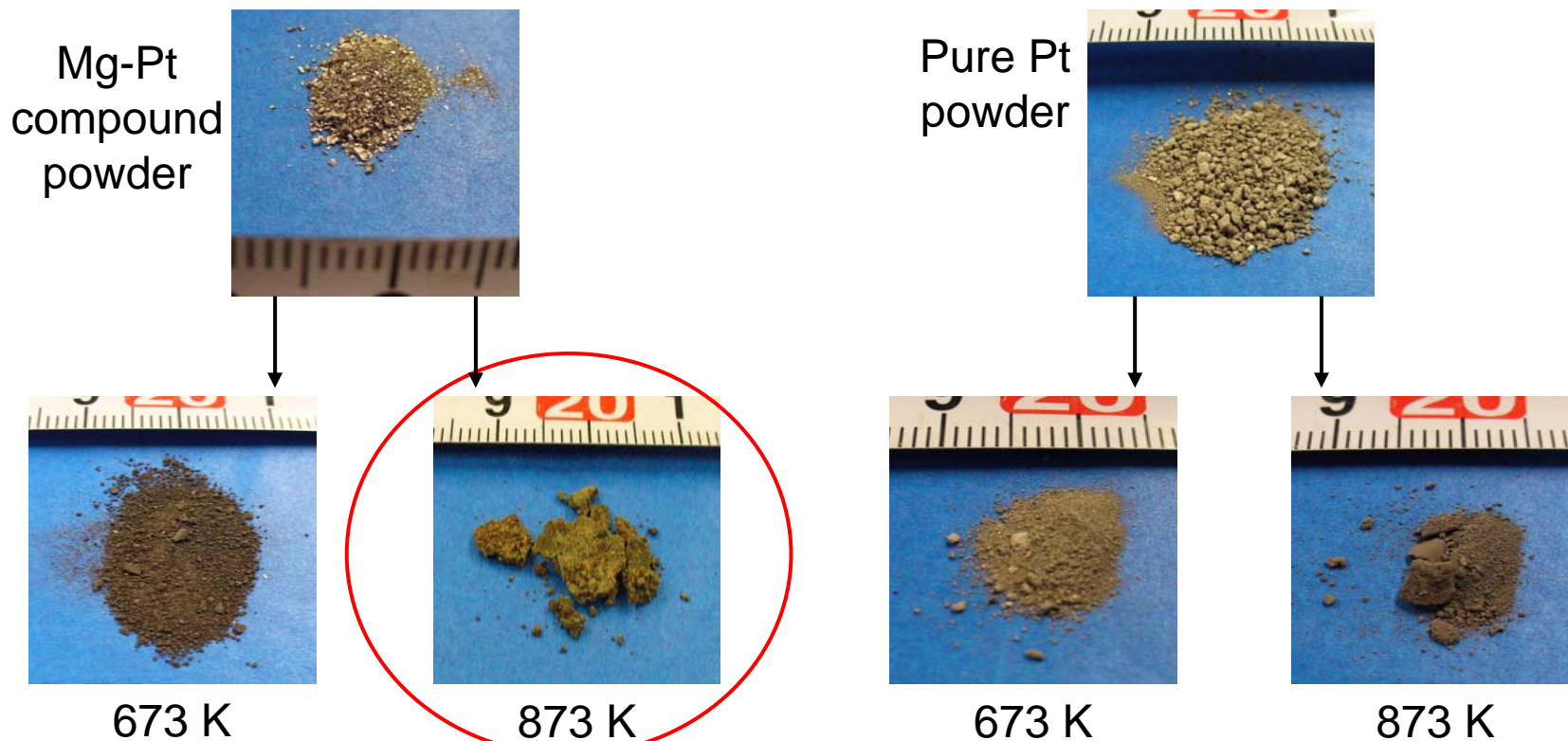
Chlorination of Mg-Pt compounds and Pt



Feed samples were chlorinated by using a chlorinating agent (Cl₂, FeCl₃, or CuCl₂ gas) at 673 or 873 K for 3 h.

Compounds obtained after chlorination

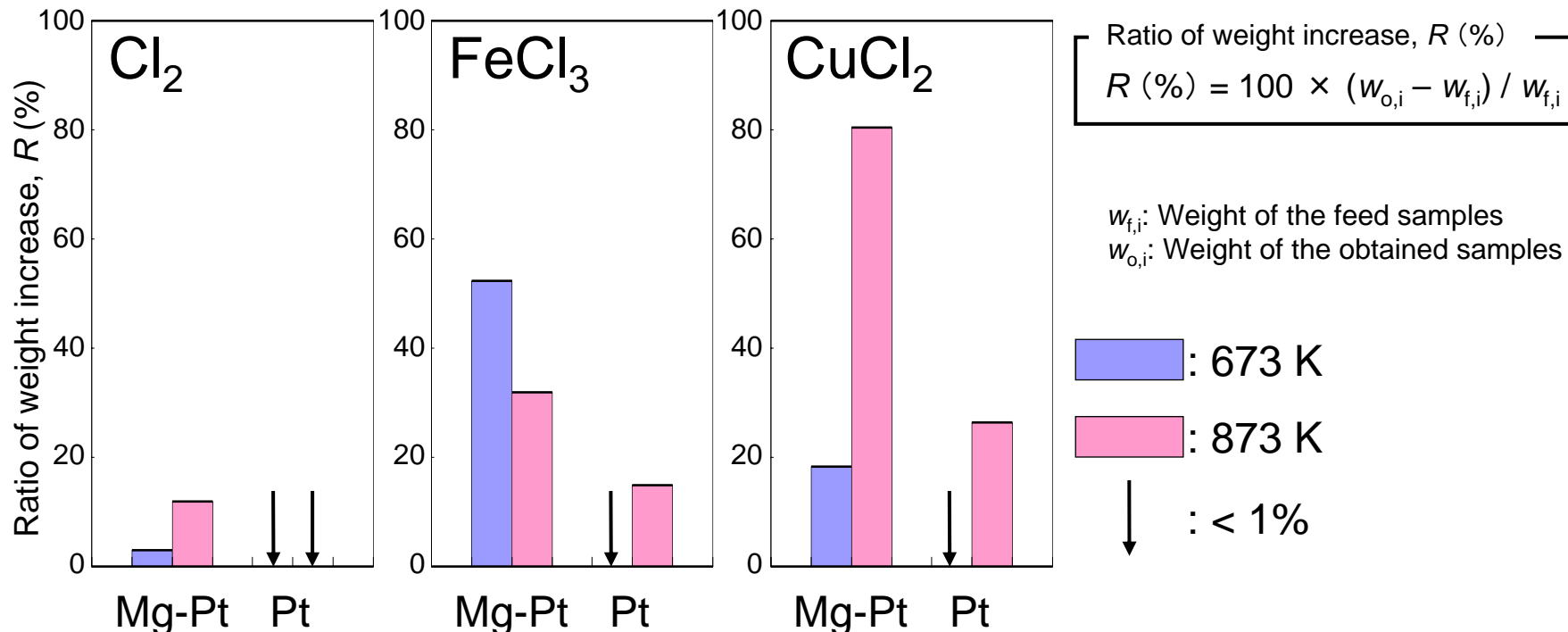
After chlorination in CuCl_2 at 673 K and 873 K for 3h



→ The morphologies and colors of the samples were different.

Weight measurement

Comparison of weight change

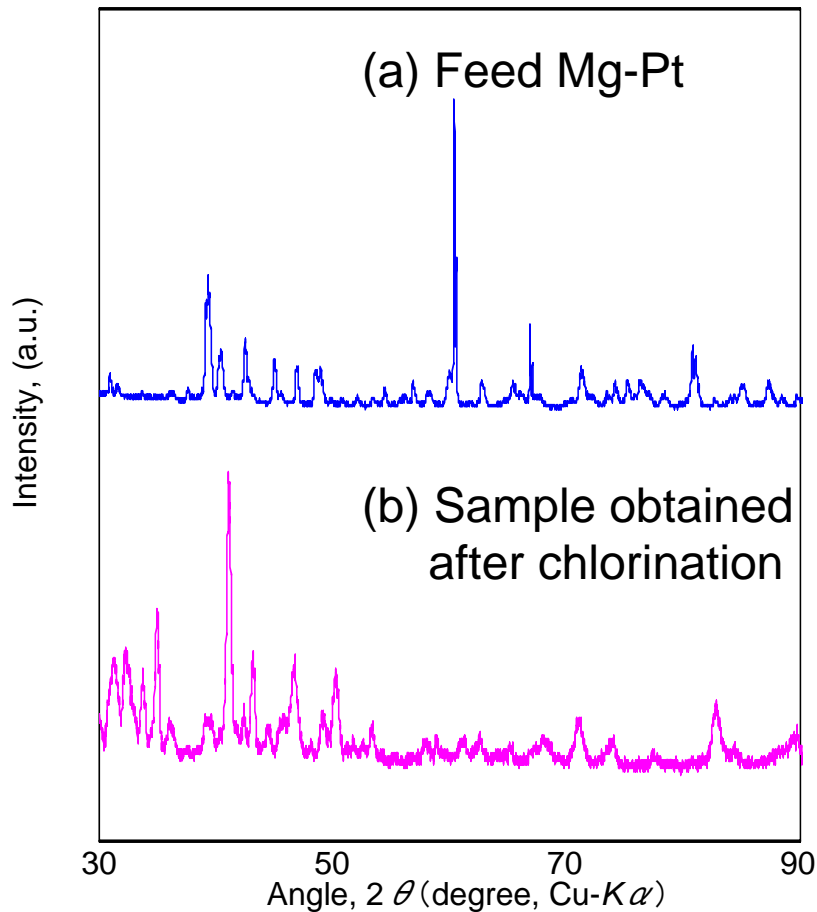


Effective chlorinating condition:

- (1) Mg-Pt compound
- (2) High temperature (873 K was more effective than 673 K)
- (3) Chloride salts

XRD analysis

Chlorination agent: CuCl_2
Reaction temperature: 873 K



The sample obtained after chlorination was different from the feed Mg-Pt.

However, their phases were not identified.

Composition analysis

Chlorination agent: CuCl_2
Reaction temperature: 873 K

Sample	Analysis	Composition of element i , C_i (mass%)				
		Mg	Pt	Cu	Fe	Cl
Feed Mg-Pt	XRF	12.2	87.8	—*	<0.1	—*
	ICP-AES	16.6	71.9	<0.1	1.3	—*
Obtained Sample	XRF	5.8	15.3	4.0	21.3	51.5
	ICP-AES	9.2	45.6	5.2	8.7	—*

*Not detected

Cu of CuCl_2 participated in this chlorination.

Summary

A fundamental technique that utilizes the selective alloying of PGMs using collector metals followed by chlorination/oxidation.

1. Pt was reacted with Mg at 1173 K and the obtained Mg-Pt compounds were “chlorinated” by using the vapors of a chlorinating agent (Cl_2 , FeCl_3 , or CuCl_2) at 673 K and 873 K.
2. During chlorination, Pt was effectively reacted with chloride salts at 873 K after Mg alloying. After the experiment, Pt formed a complex compound.

Future work:

Integration of the proposed chlorination method with the conventional dissolution methods of chlorinated Pt in acid solution will be investigated.