【3RF-1902】

Methodological Development in Recycling Platinum Group Metals Using Specific Ion-Pair Formation

MATSUMOTO Kazuya
Akita University
1-1 Tegatagakuen-machi, Akita-shi, Akita 010-8502, JAPAN
E-mail: kmatsu@gipc.akita-u.ac.jp

Key words: platinum group metals, recycle, primary amines, precipitation, ion-pairs, ionic crystals, automobile catalysts

Platinum group metals (PGMs) are of crucial importance because of their wide range of applications, such as automobile catalysts and electrical devices. Despite the increasing demand for PGMs, their availability remains limited due to their scarcity in nature and regional maldistribution. Therefore, efficient recovery and separation processes are necessary for recycling PGMs from post-consumer scrap. In this study, we aimed to develop selective PGM recovery methods using primary amines as precipitants or extractants. Moreover, we analyzed PGM recovery mechanisms in detail.

We succeeded in preferential and selective recovery of Rh from metal-containing HCl solutions using an aromatic primary diamine as a precipitant or an aromatic primary monoamine as an extractant. Highly selective Rh precipitation was achieved from metal-mixed HCl solutions using *p*-phenylenediamine as a precipitant (Fig. 1). We revealed that the formation of stable ionic crystals containing Rh was the key to selective Rh precipitation, achieved selective recovery of Pt by precipitation using 2-ethylhexylamine or *m*-phenylenediamine, clarified that Ir (III) could be separated from Pd and Pt by precipitation using aromatic primary monoamine and diamine compounds, and also succeeded in separating Ir (IV) and Rh by precipitation using 2-ethylhexylamine by oxidation of Ir (III) to Ir (IV). We found that Ru was selectively precipitated and recovered by using an aromatic primary monoamine compound, and that Pd could be selectively recovered by solvent extraction using a 4-aminobenzophenone derivative as an extractant. Furthermore, mutual separation of Pt, Rh, Pd in this order could also be successfully achieved using a diamine compound having benzylamino groups (*m*-xylylenediamine) as a precipitant (Fig. 2). Detailed studies of the PGM recovery mechanisms revealed that the stability and formation rate of the ionic crystals composed of chloro-complex anions of PGMs and amines, as well as basicity, solubility and steric effect of the amines controlled PGM selectivity.

In this study, all PGMs other than Os were targeted for selective recovery, and selective PGM recovery was achieved using primary amine compounds as recovery agents. The recovery methods developed in this study have promise for use in practical PGM recycling from secondary resources.

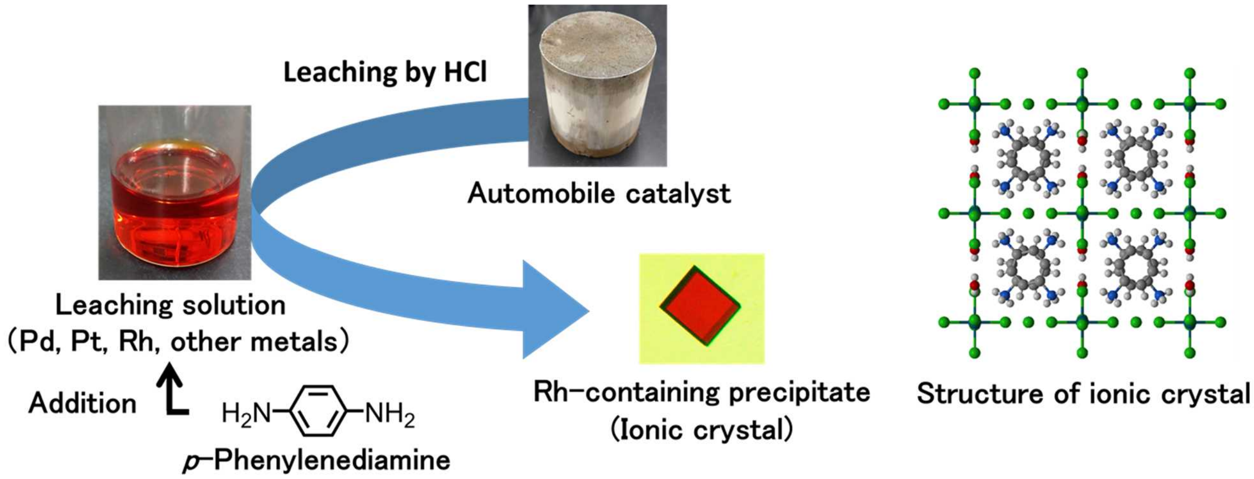

Fig. 1 Schematic image of the selective recovery of Rh using *p*-phenylenediamine as a precipitant.

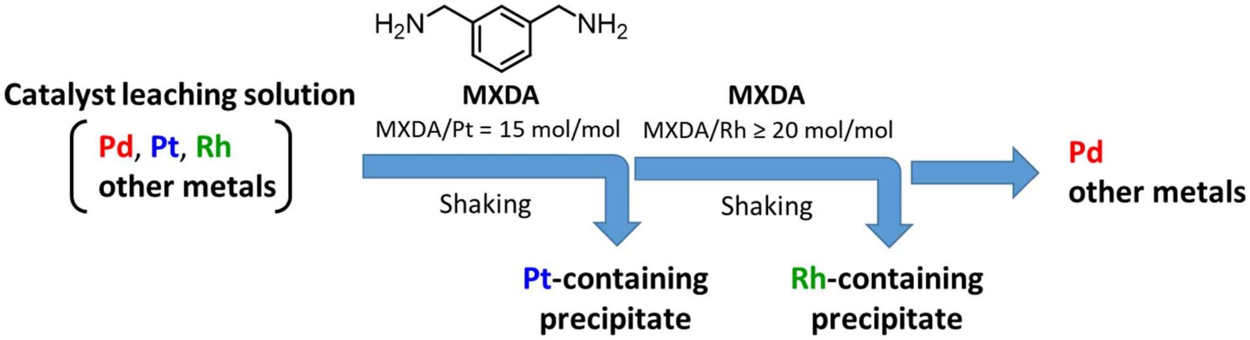

Fig. 2 Mutual separation of Pt, Rh and Pd using *m*-xylylenediamine as a precipitant.