Development of selective solidification/recovery method of platinum group metals from waste solutions by using polymer crosslinking reactions

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A novel crosslinking polymer which can adsorb platinum group metals (PGMs) was synthesized. We found that the synthesized polymer enables to recover Pd^{2+} selectively from waste solutions and solidify as a gel matrix.

Keyword : Platinum group metals, Crosslinking polymer, Adsorption, Solidification

1. Introduction

PGMs from high-level radioactive liquid wastes has become a crucial issue for ensuring the quality of the vitrification process. Various separation techniques based on solvent extraction and chromatography have been investigated, but generate environmental and safety risks such as production of secondary wastes and fire and explosion. In this work, we aimed to create a novel crosslinking polymer matrix which has the coordination ability for PGMs and porous structures.

2. Experimental

The crosslinking polymer consisting of polyvinyl alcohol (PVA) backbone and thione and carbonyl imidazole moieties (TCDI) was synthesized as follows. PVA and TCDI were mixed in DMF under Ar atmosphere, and then gently stirred at 50 °C . The reaction was quenched with ethanol, and the solid precipitant was filtered and washed with ethanol. After drying, the product TCDI-PVA was obtained as white powder (Fig.1). Moreover, in order to examine PGMs adsorption performance of TCDI-PVA, adsorption experiments of Pd^{2+} in aqueous solutions were performed at several reaction times. The Pd^{2+} concentrations in aqueous phase were determined by ICP-MS, and Pd^{2+}-adsorbing TCDI-PVA solid samples were examined by KBr-IR, SEM/EDX, and so on.

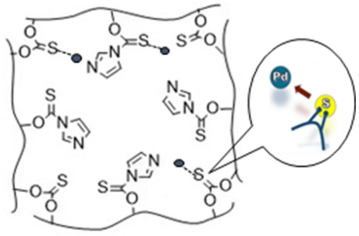

Fig.1 Schematic illustration of PGM adsorption on crosslinking polymer TCDI-PVA.

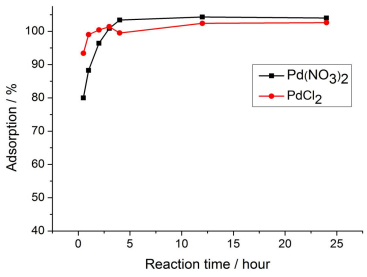

Fig.2 Uptake of Pd^{2+} on TCDI-PVA *vs.* times.

3. Results and Discussion

It was found that KBr-IR spectrum of the synthesized TCDI-PVA shows important adsorption peak at around 1200 cm^{-1} assigned as C=S stretching mode and the peak is shifted by the Pd^{2+} adsorption. This result indicates that the donating side (sulfur atom) of TCDI could be directly coordinated with Pd^{2+}. The porous structures of TCDI-PVA was confirmed to be formed by SEM image. Moreover, the Pd^{2+} adsorption results showed that TCDI-PVA could recover Pd^{2+} completely from HNO_3 and HCl solutions in a few hours. In addition, the Pd^{2+}-adsorbing TCDI-PVA enabled to solidify as a gel matrix.

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