

# Electrochemical Dissolution of Platinum in a Chloride-Based Molten Salts

Suhee Choi<sup>\*</sup>, Sang-Eun Bae, and Tae-Hong Park

Korea Atomic Energy Research Institute, 111 Daedeock-daero, Yuseong-gu, Daejeon, Korea

<sup>\*</sup>shchoi926@kaeri.re.kr

## 1. Introduction

Pt is precious transition metal that has outstanding catalytic and electrical properties. Pt has been widely used in many applications, such as catalysts for chemical reaction and fuel cells and electrode material in chemical processes.

Pt is widely used as an electrode material in the electrochemical system because it is one of the most inert materials. These days, stability of Pt is one of key issues in pyrochemical process. Pt is used as a counter electrode in the electro-reduction process where the Pt is easily dissolved during the operation of the process [2]. In order to prevent the dissolution of Pt in the high temperature molten salt, it is needed to acquire the electrochemical properties of Pt in the molten salt.

In the present work, we investigated electrochemical dissolution of Pt in the various chloride-based molten salts. by using linear sweep voltammetry (LSV) and chrono-amperometry (CA).

## 2. Experimental

All the experiments were carried out in a glove box under Ar. The O<sub>2</sub> and H<sub>2</sub>O level were maintained to be less than 1 ppm. Lithium chloride (LiCl)/potassium chloride (KCl) eutectic salts (anhydrous beads), lithium chloride (LiCl), calcium chloride (CaCl<sub>2</sub>) and silver chloride (AgCl) were obtained from Sigma Aldrich.

Electrochemical studies were performed using a quartz tube (20 mm in outer diameter and 2 mm in wall thickness). Pt wire (DSM, dia. 1 mm) and glassy carbon (Alfa Aesar, dia. 2 mm) electrodes were used as the working and counter electrodes, respectively. The reference electrode was Ag wire includes 1 mol% AgCl in the LiCl-KCl eutectic melt.

The electrochemical experiments were performed using a Gamry Reference 3000.

## 3. Results and Discussion

It is well-know that the Pt dissolution reaction is impeded due to the formation of a passivation layer on the electrode surface where the passivation layer is composed of K<sub>2</sub>PtCl<sub>6</sub> [3]. Fig. 1 shows the linear sweep voltammograms (LSVs) of Pt in various chloride-based molten salts. The anodic current began to increase at 0.69 V in LiCl-KCl (Fig. 1a) and then to be suddenly dropped. This reaction is attributable to the formation of the passivation layer.

In case of LiCl melt, the increment of current was observed from 0.683 V to 1.2 V. After passing the 1.2 V, the current was slightly decreasing. In this case, the decrease of the current resulted from the decrease of the electrode surface area.

We also measured the LSVs in the LiCl melt after adding KCl to the LiCl melt. The result showed that the passivation layer started to form after adding 10 wt% KCl (Fig. 1c).

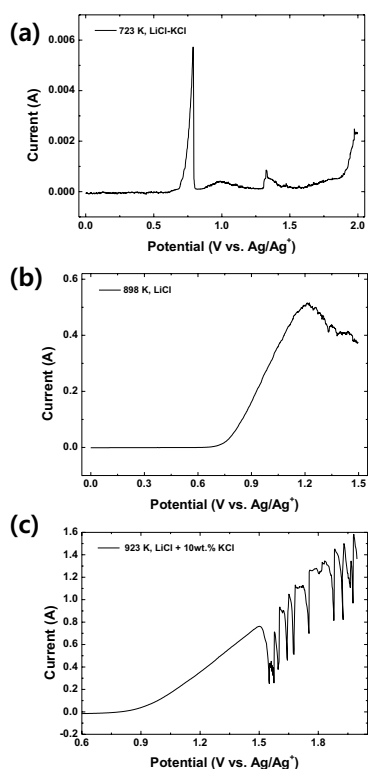


Fig. 1. LSV obtained dissolution of Pt in the (a) LiCl-KCl and (b) LiCl. (c) CV obtained dissolution of Pt in the LiCl + 10wt% KCl.

By using the LSVs, we also built Tafel graphs for the Pt dissolution reactions and estimated Tafel slope, exchange current, etc.

#### 4. Conclusion

Here, we studied the dissolution of Pt in the various chloride-based molten salts. In the LiCl-KCl molten salt, the formation of the passivation film was observed during the dissolution of Pt while the dissolution of Pt continuously occurred in LiCl. The adding 10 wt% KCl to the LiCl melt induced the formation of the passivation layer, indicating that the addition of the KCl can reduce the loss of the Pt during the electro-reduction process.

#### REFERENCES

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