

## Preparations of Metal Monolayer Islands Using Self-assembled Monolayer Technique

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It has been found in our previous study<sup>1)</sup> that underpotential deposition (UPD) of several kinds of metals can be made even on a gold electrode coated with a self-assembled monolayer (SAM) of alkanethiol. In this case, numerous islands of metal atomic monolayer are initially generated and they grow gradually with polarization time, allowing us to prepare monolayer islands having desired sizes. Then the electrochemical properties of the metal monolayer island can be investigated after removing the adsorbed thiol molecules by electrochemical means. For the first demonstration on electrocatalytic analysis of the metal monolayer islands, we investigated oxygen reduction on Ag monolayer islands-deposited Au electrode. It has been, then, found that there is a threshold value in the island size against oxygen reduction with 4-electron reaction.<sup>2)</sup>

In cases of noble metals such as platinum, of which ions do not exhibit UPD behavior, preparation of monolayer islands is strongly required for clarifying the nature of these metals. Here, we would like to present shortly a novel method allowing preparation of monolayer islands of noble metals including Pt<sup>3)</sup> and Pd on an Au substrate. The procedures are schematically illustrated in Fig. 1. An alkanethiol SAM having nano-size pores is prepared by the method that we have developed.<sup>4)</sup> UPD of Cu is made at the nanopores, then the prepared Cu monolayer islands are replaced with Pt by utilizing difference in the electrode potential between oxidation of the Cu monolayer and reduction of Pt compound. Pt monolayer islands of an average diameter of 8 nm are shown in figure 2. The electrochemical properties of the metal monolayer islands will also be discussed.

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### References

- 1) D. Oyamatsu, M. Nishizawa, S. Kuwabata, H. Yoneyama, *Langmuir*, **14**, 3298 (1998).
- 2) A. Kongkanand, S. Kuwabata, *Electrochemistry Commun.*, **5**, 133 (2003).
- 3) A. Kongkanand, S. Kuwabata, *Electrochemistry*, **72** (2004), *in press*.
- 4) H. Munakata, S. Kuwabata, Y. Ohko, H. Yoneyama, *J. Electroanal. Chem.*, **496**, 29 (2001).

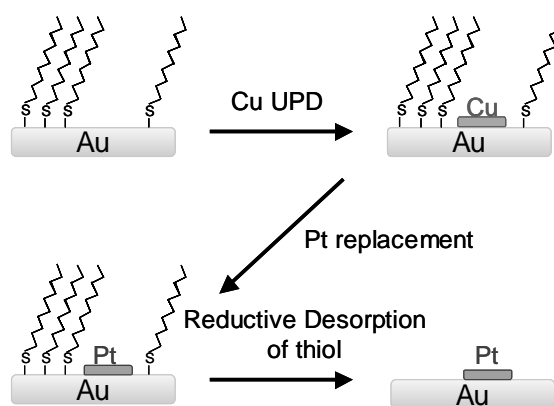


Figure 1. Schematic illustration of procedures for preparation of Pt monolayer islands.

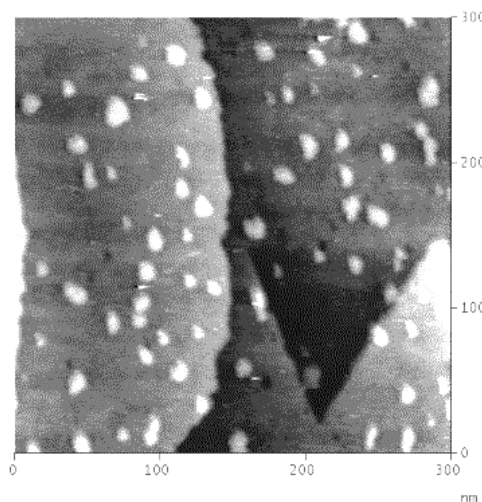


Figure 2. Scanning tunneling microscopic image(300×300 nm<sup>2</sup>) of Pt monolayer islands having an average diameter of 8 nm.