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Electro-Chemical Properties of Metal Complex Effect in G4-48 Crown-4 Dendrimer Monolayers

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In the electro-chemical properties, this increase indicates an increase in the capacity for dendrimer monolayer, confirming the complex of metal ion. The AFM images show the differences in the surface morphology between dendrimer and included Li^+ monolayers. Importantly, these results conclusively demonstrate that the surface of the dendrimer-encapsulated Li^+ and Cs^+. The current increased with the applied voltage and with metal ion complex.

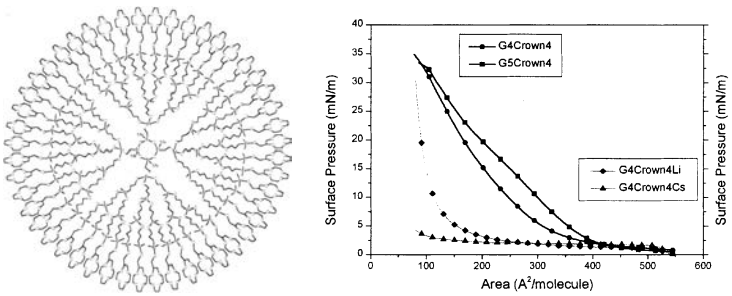
Keywords: crown dendrimer, electrochemical, metal complex, I-V

INTRODUCTION

Dendrimers represent a new class of synthetic macromolecules characterized by a regularly branched treelike structure [1,2]. On the other hand, the quartz crystal has been known as a sensitive mass-detecting device and a liquid viscosity-monitoring device [3]. The reproducibility of organic film-coated quartz crystals with a general coating method is sometimes questionable because it is difficult to recreate the same conditions of the thin film. To cope with this limitation, our group suggested LB (Langmuir-Blodgett) film technology for fabricating the thin film on the surface of the quartz crystal [4]. We investigated the monolayer behavior, morphologies, electrochemical and electrical properties of crown dendrimer.

EXPERIMENTAL

The surface pressure-area (π-A) isotherms were investigated using Moving-wall Method of NL-LB200-MWC (NLE, Japan). A potentiostat (Solartoron) was used, and the working electrode terminal was connected to the quartz crystal electrode terminal. An Ag/AgCl electrode was used as the reference electrode and a Pt electrode was used as the counter electrode.



(a) Molecular structures (b) π-A isotherms

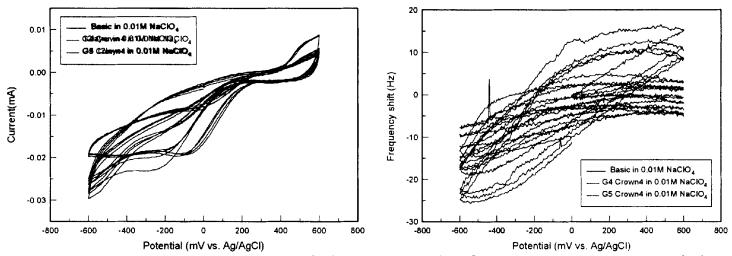
FIGURE 1. Molecular structures and π-A isotherms

RESULTS AND DISCUSSION

Figure 1 shows surface pressure-area (π-A) isotherms of crown dendrimer on a pure water. The larger molecular area of G4-48 crown-4 included Li^+ and Cs^+ seems to be ascribed to the increased hydrophilicity and molecular interaction by metal complex effect.

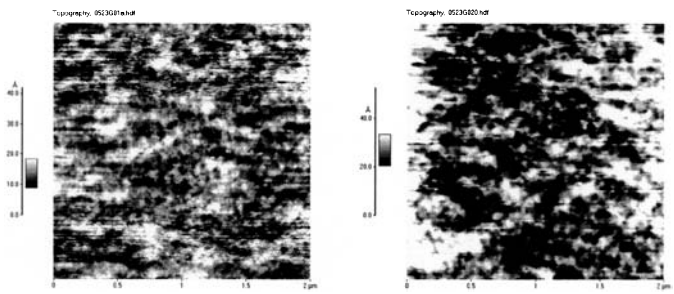
Figure 2 shows the change in the current and resonant frequency during the cyclic voltammogram for the electrochemical reaction of dendrimer. In Fig. 2(a), the base current increased according to the increase in cycle time. This increase indicates an increase in the capacity for dendrimer monolayer, confirming the complex of metal ion.

In Fig. 2(b) the resonant frequency decreases at the potential for the metal ion complex. The amplitude of the frequency change correlated with the increase in the current.



(a) current vs. potential (b) frequency vs. potential

FIGURE 2. Cyclic voltammogram of dendrimer monolayer.



(a) G4-48 crown-4 (b) G4-48 crown-4 with Li^+

FIGURE 3. AFM images of dendrimer monolayer.

In Fig. 3, the AFM images show the differences in the surface morphology between dendrimer and included Li^+ monolayers, such as molecular packing density, homologous series, film thickness. We conclude that surface morphology of G4-48 crown-4 monolayer is smooth and homogeneous and has optimal hydrophobicity and good stability, whereas G4-48 crown-4 included Li^+ monolayer give rougher surfaces with more excess material.

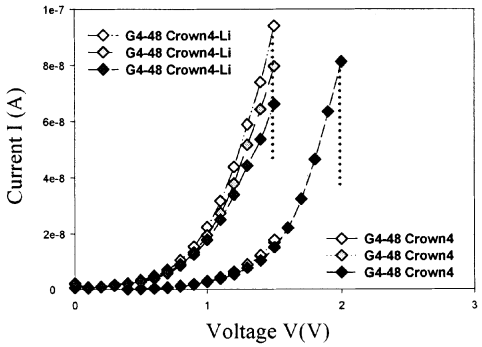


FIGURE 4. I-V characteristics of crown dendrimer monolayers.

Figure 4 shows the typical current-voltage characteristics of dendrimer monolayers [5]. The current increased with the applied voltage and with metal ion complex. The conductivity σ of dendrimer monolayers were about 1.0×10^{-15} and 1.5×10^{-14}[S/cm], respectively, which corresponds to these of the insulating properties. This phenomena could be described by the difference of metal ion complex which was adhered at dendrimer functional group. It was considered that metal ion complex is affected the I-V characteristics. But, we could not obtain the accurate response mechanism yet.

Acknowledgment

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