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Effect of Complex on Electrical Properties of Dendrimer LB Films Containing 48 Pyridinealdoxime

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1. Introduction

Dendrimers represent a new class of synthetic macromolecules characterized by a regularly branched treelike structure [1]. Dendrimer can be made with high regularity and controlled molecular weight [2]. Dendrimers, also termed "starburst polymers" process a highly branched molecular topology and physical properties that are determined by their globular, spherical shape. Peculiar features of the dendritic geometry are the large number of end groups as well as the shape persistence in higher generations, approaching spherical geometry [3]. A new class of macromolecules polymer, dendrimers have a potential ability such as catalysts, drug delivery and chemical sensors and so on [4]. In this study, we attempted to fabricate a G4-48PyA dendrimer Langmuir-Blodgett (LB) films containing 48 pyridinealdoxime functional end group that could form a complex structure with metal ions. Also, we investigated the surface activity of dendrimer films at air-water interface. And we have studied the electrical properties of the ultra-thin dendrimer LB films. Thus, investigation of the surface activity as well as of the electrical properties of LB films of G4-48PyA is important for their potential use in molecular electronic nanodevices.

2. Experimental

The dendrimer containing 48 pyridinealdoxime was synthesised by the use of siloxanetetramer (2,4,6,8-tetramethyl-2,4,6,8-tetravinylcyclotrtrasiloxane, $((CH_2=CH)MeSiO)_4$) as the core molecule, hydrosilation with $HSiMenCl_{3-n}$ and alcoholysis with allylalcohol. By the two alternative processes, bydrosilation and alcoholysis, the dendrimer carried out up to the fourth generation with 48-Cl on the periphery. And then, G4P-48-Cl dendrimer was terminated with 4-pyridinealdoxime. The dendrimer is characterized by NMR, GPC, UV/VIS, IR and elementary analysis. The molecular structure is shown in fig. 1. The surface pressure-area (π-A) isotherms were investigated by using a LB trough (Nippon Laser and Electronics Lab., NL-LB200-MWC Moving Wall Method). The LB films were transferred onto slide glass for measurement of electrical properties. For the electrical properties of the LB films, upper Al electrodes with a diameter of 5 mm were deposited on the film surface by vacuum evaporation method to form a Al/dendrimer LB films/Al sandwich structure, metal/insulator/metal (MIM) structure. A DC power supply and a electrometer were used to measure the current-voltage (I-V) characteristics.

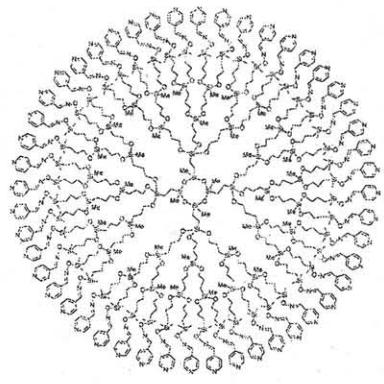

Fig. 1 G4-48PyA dendrimer molecular structure.

3. Results and discussion

Figure 2 shows the surface pressure-area isotherms for the monolayers of pure G4-48PyA and its mixtures with Pt^{4+} ions on pure water surface. The stable condensed films were formed at the air-water interface, which mean the dendrimer can be applied to LB method. And the difference on limiting area has been generated by the metal ions effect, that is, it has more expanded state in the case of Pt^{4+} ions, and we expects that it can result in the differences on the electrical properties. The electrical properties of dendrimer LB films were investigated by measuring the leakage current I versus applied voltage V, which is shown in Fig. 3. The I-V characteristics show an asymmetry behavior. For example, more current are observed for forward direction, which means that this devices clearly exhibits rectifying behavior. The rectification ratio was increased with the applied voltage for the device. And the devices fabricated with Pt^{4+} ions had larger current than

pure G4-48PyA dendrimer. And those phenomena can be explained through the effect of metal ions. In conclusion, it is demonstrated that the metal ion around G4-48PyA dendrimer can contribute to make formation of network structure among dendrimers and result in change of electrical properties.

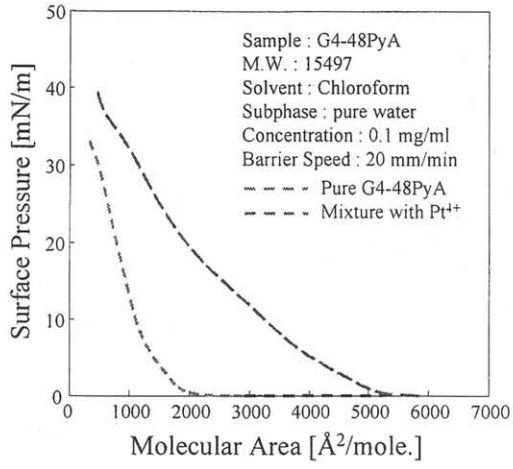

Fig. 2 π-A isotherm of G4-48PyA dendrimer.

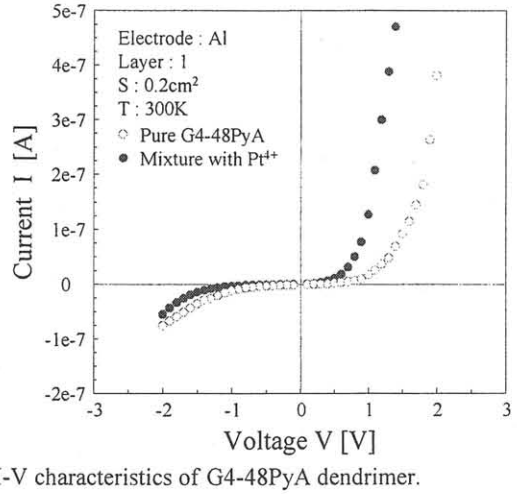

Fig. 3 I-V characteristics of G4-48PyA dendrimer.

4. Conclusions

We attempted to fabricated a ultra-thin dendrimer LB films containing 48 pyridinealdoxime end group. That could form a complex structure with metal ions. In this study, the samples for electrical measurement were fabricated by two types, that is, pure G4-48PyA dendrimer and mixture one with Pt^{4+} ions. The surface Pressure-area isotherms show stable condensed films form and effect of metal ions through change of area per molecular. And the electrical properties were rectifying behavior and effect of metal ions through comparative current value the same voltage.

Acknowledgments

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