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Electrical Properties of G4-48PyP Dendrimer LB Films

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We attempted to fabricate a G4-48PyP dendrimer LB films containing 48 pyridinepropanol functional end group that could form a complex structure with metal ions. Also, we investigated the surface morphology activity of dendrimer films. And we have studied the electrical properties of the ultra-thin dendrimer LB films. The electrical properties of the dendrimer LB films were investigated by studying the current-voltage characteristics of metal/dnedrimer LB films/metal (MIM) structure. Rectifying behavior of the devices was occurred in applied field.

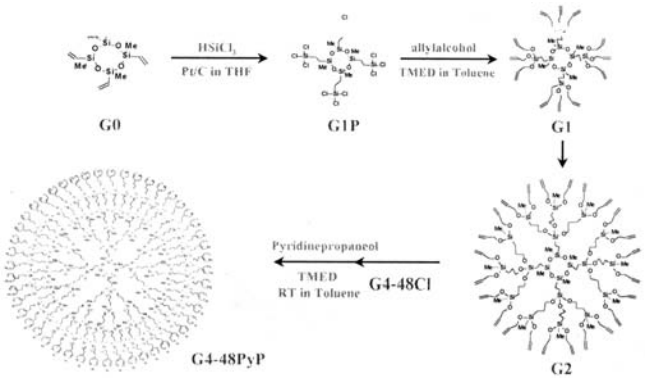
Keywords: Dendrimer; LB films; Electrical properties

INTRODUCTION

A research area, which has obtained increasing interest during the last decade concerns improvement of macromolecular properties by changing the macromolecular architecture. One of the most peculiar characteristics of dendritic macromolecules is their controlled molecular structure and orientation, which means that they have a practical application in achieving a highly organized molecular arrangement [1]. . It is obvious that any molecular device to have uniform and well-defined properties must consist from molecules, which is arranged in a well ordered configuration. Also, the monolayers and Langumuir-Blodgett (LB) film of dendrimers have been studied

extensively [2, 3]. In this paper, we attempted to fabricate a G4-48PyP dendrimer Langmuir-Blodgett (LB) films containing 48 pyridinepropaneol functional end group that could form a complex structure with metal ions. We investigated the surface activity of dendrimer films at air-water interface. The electrical properties of the ultra-thin dendrimer LB films were investigated by studying the current-voltage characteristics of metal/dendrimer LB films/metal (MIM) structure. And rectifying behavior of the devices was occurred in applied field.

EXPERIMENTAL

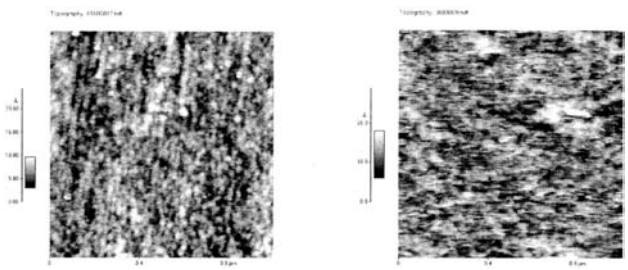


SCHEME 1. Synthetic way of pyridinepropanol group containing dendrimer.

The dendrimer containing 48 pyridinepropanol 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, hydrosilation 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-pyridinepropanol. Final compound, G4-48PyP has 48-pyridinepropanol on the outermost periphery of dendrimer (Schme 1). As the pyridinepropanol functional group has property of Lewis base on nitrogen atom, it formed complex with metal ions easily. The LB films were transferred onto slide glass for measurement of electrical properties. For the electrical properties of the LB films, an upper aluminium(Al) electrode was deposited on the film surface by using the vacuum evaporation method to form a Al/dendrimer LB films/Al sandwich structure. A DC power supply and a HP 3458A Multimeter were used to measure the current - voltage (I-V) characteristics.

RESULTS AND DISCUSSION



(a) pure G4-48PyP (b) mixture with Pt^{4+} ions

FIGURE 1. AFM image of G4-48PyP dendrimer monolayer.

In Fig. 1, the AFM images show the differences in the morphology between pure G4-48PyP dendrimer and mixture with Pt^{4+} ions, such as molecular packing density. The surface morphology of the dendrimer LB films of mixture with Pt ions looks for network shape to compare with pure one. It should be imply that Pt ion is contributed to cross-linking and branching reaction between dendrimers.

The electrical properties of dendrimer LB films were investigated by measuring the leakage current I versus applied voltage V, which is shown in Fig. 2. The I-V characteristics show asymmetric and nonlinear. In the forward bias direction, there is a suppression of the current up to about 1.0 V after which the current starts to increase. The forward currents follow approximately an exponential trend. In contrast, very little current flows when applying a reverse bias. This device exhibits moderate rectifying behavior, due to the injection of the charge carriers from the electrode to the polymer. The rectification ratio increases with applied voltage for the devices. This exponential dependence can be effect of metal ions to a formation of the dendrimer LB films.

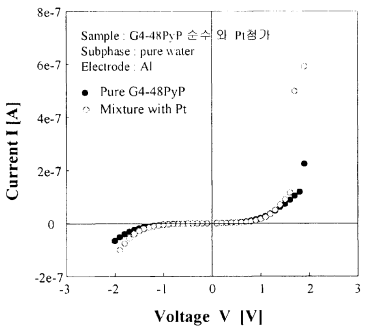


FIGURE 2. I-V characteristics of G4-48PyP dendrimer monolayer.

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