한국전기전자재료학회 2006년도 영호남 합동 학술대회 및 센서박막
재료연구회 / 기술교육위원회 춘계학술대회 논문집 (2006. 5. 19)

전력 소자용 유기박막의 전기적 특성

송 진원*, 최 용성**, 문 종대**, 이 경섭**
*한국기계연구원, **동신대학교 전기공학과

Electrical Properties of Organic Thin Film for Power Device

Jin-Won Song*, Yong-Sung Choi**, Jong-Dae Moon**, and Kyung-Sup Lee**
*KIMM, **Department of Electrical Engineering, DongShin University

Abstract : Monolayers of lipids on a water surface have attracted much interest as models of biological membranes, but also as precursors of multilayer systems promising many technical applications.Until now, many methodologies have been developed in order to gain a better understanding of the relationship between the structure and function of the monolayers. Maxwell displacement current (MDC) measurement has been employed to study the dielectric property of Langmuir-films. MDC flowing across monolayers is analyzed using a rod-like molecular model. A linear relationship between the monolayer compression speed and the molecular area Am. Compression speed was about 30, 40, 50mm/min. Langmuir-Blodgett(LB)layers of Arachidic acid deposited by LB method were deposited onto slide glass as Y-type film. The structure of manufactured device is Au/Arachidic acid/Al, the number of accumulated layers are 9~21. Also, we then examined of the Metal-Insulator-Metal(MIM) device by means of I-V. The I-V characteristics of the device are measured from -3 to +3[V]. The insulation property of a thin film is better as the distance between electrodes is larger.

Key Words : Maxwell displacement current (MDC), Langmuir-films, MIM device

1. Introduction

In the Langmuir-Boldgett(LB) technique, a monolayer on the water surface is transferred on to a substrate, which is raised and dipped through the surface, and one can obtain multilayers in which constituent molecules periodically are arranged in layer. The LB technique has attracted considerable interest in the fabrication of electrical and electronic device, e.g.. Many researchers have investigated the electrical properties of monolayer and multiplayer films. [1][2]

Before grasp electrical and electronic properties, that observe surface structure of LB film and grasp the properties is important. Insoluble monolayers on water surface exhibit various phases, and they are interesting as two-dimensional and interfacial system in the fields of physics, chemistry and electronics.

In this paper, we give pressure stimulation into organic thin films and then manufacture a device under the accumulation condition that the state surface pressure is 2, 10, 30[mN/m](gas state, liquid state, and solid state). The physicochemical properties of the LB films on the surface of pure water are studied by AFM.[3] Also, we then examined of the Metal-Insulator-Metal(MIM) device by means of I-V.

2.Experiment

Chemical structure of a AZ-G4 monomer shows in Figure 1. Monolayers of arachidic acid were spread from dilute chloroform solutions (0.5 *mmol*) onto the surface of pure water. The working area of electrode 1 was 45.6 [cm2]. The distance d between electrode 1 and the water surface was 1 [mm]. The displacement current I was measured by an electrometer (Keithley 6517).

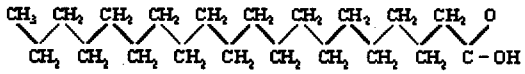

FIGURE 2. Molecule structures of Arachidic acid

Arachidic acid was spread on pure water(pH 6.0, 18.2 M cm) and maintained at 20 [℃]. After a monolayer was rested for 5 minutes, the monolayer was compressed at a compression speed of 30, 40, 50 [mm/min]. MDCs were measured during monolayer compression.

The AFM observations have been done with an AFM(Digital Instrument Nano Scope) along with estimation of surface roughness.

LB layers of Arachidic acid deposited by LB method were deposited onto slide glass as Y-type film. The structure of manufactured device is Au/Arachidic acid/Al, the number of accumulated layers are 9~21. Also, we then examined of the Metal-Insulator-Metal(MIM) device by means of I-V. The I-V characteristic of the device are measured from -3 to +3[V].

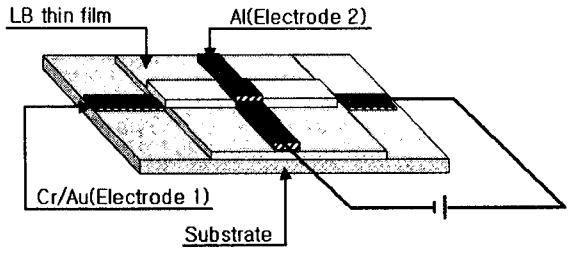

FIGURE 2. Structure of MIM

3.ResultandDiscussion

Figure 3 shows a typical example of MDCs, where MDCs were initiated to flow at the molecular area A=A0, due to the phase transition from the isotropic planar alignment phase on water surface (Range 1) to the polar orientational isotropic phase (Range 2). MDC peaks appear in the range of molecular area A between 51 and 25[Å2](Range 2) by monolayer compression.

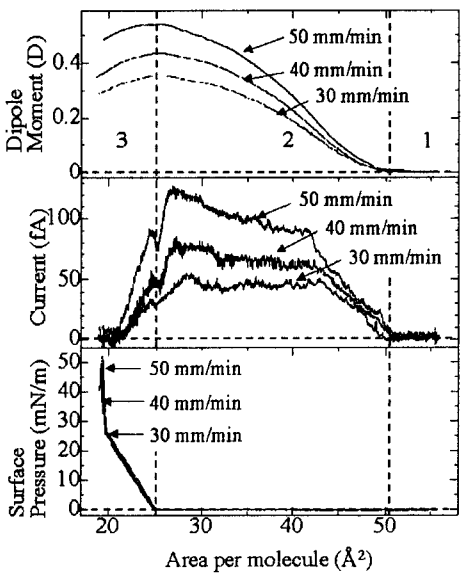

FIGURE 3. π-A, I-A, D-A of barrier compress

Figure 4 shows are roughness result of LB film surface that deposition by solid state. Distinction of molecule border side was not clear, and could know that roughness appears greatly. Also, Image of LB film could know that is displaying very big and irregular form.

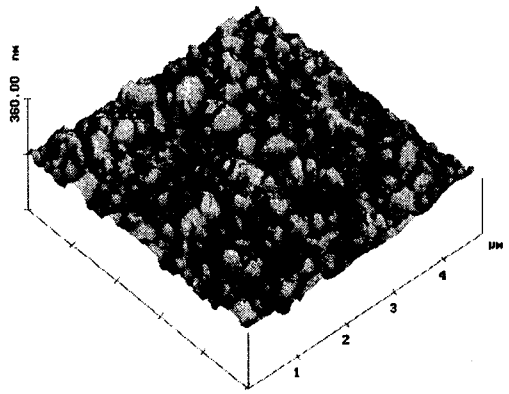

FIGURE 4. AFM image

Figure 5 is I-V characteristics that approve voltage to Cr-Au/Arachidic acid/Al device that deposition each 9, 13, 17, 21 layers and is detected. we then examined of the Metal-Insulator-Metal(MIM) device by means of I-V. The I-V characteristic of the device is measured from -3 to +3[V].In figure, current about voltage, deposition number of layer is much, could know that appear as size of current that happen in equal apply voltage is small. Also, deposition layer is small, increased with exponential function, if thickness great, curved line expressed direct ohmic characteristics. This is the insulation property of a thin film is better as the distance between electrodes is larger.

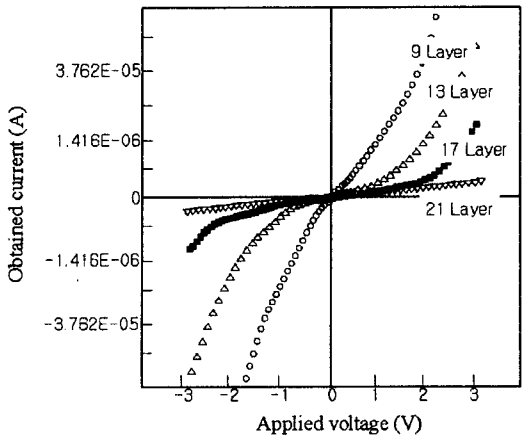

FIGURE 5. I-V characteristics

4.Conclusions

The LB films during barrier compression with the initial rise in surface pressure. The surface pressure change was generated at A=24[Å2] and see gas state(56-24 [Å2]), liquid state(24-20 [Å2]), solid state(20-19 [Å2]).We give pressure stimulation into organic thin films and then manufacture a device under the accumulation condition that the state surface pressure is 2, 10, 30[mN/m](gas state, liquid state, solid state).

The stable images are probably due to a strong interaction between the monolayer film and glass substrate. Formation that prevent when gas phase state and liquid phase state measure but could know organic matter that molecules form equal and stable film when molecules were not distributed evenly, and accumulated in solid state only.

LB layers of Arachidic acid deposited by LB method were deposited onto slide glass as Y-type film. The structure of manufactured device is Au/Arachidic acid/Al, the number of accumulated layers are 9~21. The insulation property of a thin film is better as the distance between electrodes is larger.

ACKNOWLEDGMENTS

This work has been supported by KESRI(R-2003-B-497), which is funded by MOCIE(Ministry of commerce, industry and energy)

REFERENCES

[1] Gaines G.L. jr., "insoluble Monolayers at Liquid-Gas Interfaces", Interscience, New York, 1965.

[2] Roberts G., "Langmuir-Blodgett Films", Plenum, New York, 1991.

[3] K.S.Lee, Y.S.Kwon, Y.C.Kang, "The Orientation Properties in the Stimulation Transmit of Lipid Membrane", Molecular electronics & devices, 1996.

[4] Keiji Ohara and Masaaki Nakajima,"Displacement current generated duringof fatty acid and phospholipidat the water-air interface", ThinSolid Films, 226, 1993.

[5] Y.Majima and M.Iwamoto, "A New Displacement Current Measuring System Coupled with the Langmuir-Film Technique", Review of seientific instruments, AIP, vol.62,No.9, 1991.