



## Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/gmcl19>

## Electric Properties of the IMI-O Polymer Complexed in Metal Ion

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Version of record first published: 04 Oct 2006

To cite this article: Sang-Burm Jung, Seung-Yeop Yoo, Jae-Chul Park & Young-Soo Kwon (1998): Electric Properties of the IMI-O Polymer Complexed in Metal Ion, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 316:1, 317-320

To link to this article: <http://dx.doi.org/10.1080/10587259808044518>

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Poly(N-(2-4-imidazolyl) ethyl) maleimide-alt-1-octadecene (IMI-O) polymer which can complex metal ion, was used to confirm the possibility of molecular device made by Langmuir-Blodgett method. Metal/Insulator/Metal (MIM) device was fabricated for investigating electric properties of LB film which was complex with metal ion. In the  $\pi$ -A isotherm, the surface pressures at collapse point are different as to the molecular weight of metal ions respectively. The current of LB films which were complex with metal ion had a difference as to the kinds of metal ion.

**Keyword:** polymer; complex; metal ion; electric property

## INTRODUCTION

The thin film technique using of organic molecular will be required for the sake of 'nanotechnology'. The Langmuir-Blodgett (LB) technique has some useful merits of uniform orientation, arrangement, and thickness control at molecular order as compared with other thin film techniques. Using these merits, so many researches are developed in the various area, such as sensors, electroluminescence, molecular electronic devices<sup>[1]</sup>.

Therefore, it is expected the change of electric properties LB film according to the kinds of metal ions complex<sup>[2]</sup>. In this study, the  $\pi$ -A isotherms of monolayer and the deposition state of LB films are investigated for the various metal ions. And we fabricates MIM device and measures I-V characteristics for analyze electric properties.

## EXPERIMENTAL

The material used in this study was poly(N-(2-4-imidazolyl) ethyl) maleimide-alt-1-octadecene (IMI-O) polymer which was synthesized by reaction of poly(maleic anhydride-alt-1-octadecene) with histamine. And the molecular structure is shown in Fig. 1. The LB films were transferred onto the substrate using by moving wall type trough (NL-LB200-MWC), as 1, 3, 5, and 7 layers of Y-type. The MIM structure such as Al/Al<sub>2</sub>O<sub>3</sub>/LB films/Al was fabricated to measure electric properties of LB film which was complex with various kinds of metal ions. DC power supply and Keithly 6517 electrometer was used to measure the current-voltage characteristics.

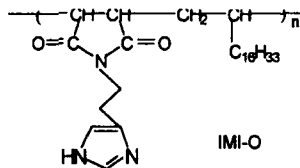
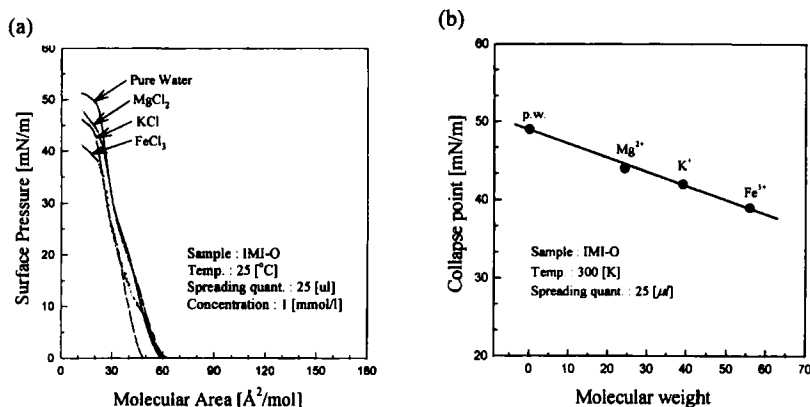


FIGURE 1 Molecular structure of IMI-O polymer.

## RESULTS AND DISCUSSION

The solution of IMI-O polymer was spread on pure water and subphase containing metal ions. The metal ions for this study were Fe<sup>3+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>. Figure 2 shows  $\pi$ -A isotherms of IMI-O polymer which were complex with metal ions.

FIGURE 2  $\pi$ -A isotherms of IMI-O polymer.

The monolayers show high stability up to the surface pressure of 35 ~ 50 [mN/m]. The monolayers of IMI-O on subphase containing metal ions show almost the same pattern as those on pure water. However, the surface pressures at collapse point were observed to have different between pure water and subphase containing metal ions. It is thought that these phenomena were occurred due to the molecular weight of metal ions.

The conductivities for various subphase didn't represent the apparent difference at ohmic region (Fig. 3). But the currents through LB films were distinguished at non-ohmic region as to the kinds of metal ions complex. The amplitudes of current density were as following;  $\text{Fe}^{3+} > \text{Mg}^{2+} > \text{K}^+$ .

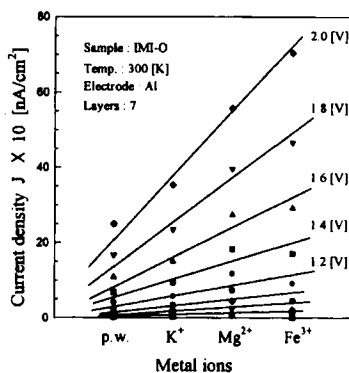


FIGURE 3 I-V characteristics for subphase of metal ions

This amplitudes were different to the electron affinity of metal which is one of the important parameters in electrical properties. But the results obtained by XPS which can investigate the quantity of metal ion concentration incorporated into the LB films have the similarity with that order. Therefore, it is thought that the quantity of metal ion complex with LB films effect on the electrical properties.

## CONCLUSION

The electric properties of IMI-O LB film which can be complex with various metal ions were investigated. And the experimental results were as following ;

- 1) In the  $\pi$ -A isotherms of IMI-O polymer, the surface pressure at collapse point have a difference due to the molecular weight of metal ions which were complex.
- 2) The current for LB films with different metal ion were dependent on the quantity complex with the interaction between metal ion and IMI-O polymer

## References

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