Structure and Properties of Aluminum Phtalocyanine Chloride Thin Films Due to Vapor Treatments

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1. Introduction
Phthalocyanine dyes have been attracting much interest for developing many kinds of electronic devices. Many studies using phthalocyanine dyes have been reported for organic solar cells, field effect transistors, organic light emitting diodes, gas sensors, secondary batteries, etc. The optical and electrical properties of phthalocyanines depend on the molecular stacking. It is known that structure of molecular stacking of aluminum phthalocyanine chloride (AlClPc) can be induced with some organic vapors [1].

In this study, AlClPc thin films were fabricated using a vacuum evaporation method and the structure and properties were investigated before and after vapor treatments. The structure and properties were examined by the measurements of optical absorption, AFM, attenuated total reflection (ATR) and emitted light due to surface plasmon (SP) excitations [2-4].

2. Experimental Details
Figure 1 shows the chemical structure of AlClPc molecule used in this work. AlClPc thin films were fabricated by a vacuum evaporation method and the structure and properties were investigated before and after vapor treatments. The structure and properties were examined by the measurements of optical absorption, AFM, attenuated total reflection (ATR) and emitted light due to surface plasmon (SP) excitations [2-4].

3. Results and Discussion
The UV-visible absorption spectra of the as-deposited film and the film treated with ethanol vapor for 10 min were shown in Fig. 2. The spectra contain the Soret and Q bands. It was found that the peak in the Q band of the film treated with ethanol vapor appeared at lower wavelength than that of the as-deposited film. After the treatment with H$_2$O vapor of the ethanol-vapor-treated film, a new peak was also observed at around 800 nm.

Fig. 2. Optical absorption spectra of as-deposited AlClPc thin film and the film treated with ethanol vapor for 10 min.

Figures 3 (a) and (b) show the AFM images of the as-deposited AlClPc thin film on Ag thin film and the film treated with ethanol vapor for 10 min, respectively. The surface roughness is found to increase markedly with ethanol-vapor treatment. The increase of the surface roughness was also observed due to H$_2$O vapor treatment. The surface roughness of the film treated with H$_2$O vapour was smaller than that treated with ethanol vapor.
Figure 4 shows the ATR properties measured at 488.0 nm for Ag thin film, as-deposited AlClPc thin film on the Ag thin film and the film treated with ethanol vapor for 10 min. It was found that the thickness evaluated from the theoretical calculations increases with the treatment of ethanol vapor. From the ATR properties due to H₂O vapor treatment, the evaluated thickness was also found to increase.

The emitted light from prism/Ag/AlClPc film is shown in Fig. 5. The curves are observed using the incident laser beam with wavelength of 488.0 nm. The peak angles of the emitted light curves correspond to resonant angles of ATR curves in Fig. 4, which suggests that the emitted lights were due to SP excitation. Furthermore, the intense emitted light was observed for the AlClPc thin film treated with ethanol vapor. It was considered to be caused by the large surface roughness of the AlClPc thin film due to the treatment with ethanol vapor. It was also observed for the film treated with H₂O vapor.

**4. Conclusions**

AlClPc thin films were prepared and the structure and properties were investigated. It was found that the structure and properties were considerably changed by the treatments with ethanol and H₂O vapors. The results in this work are useful for the development of sensing devices.

**References**


