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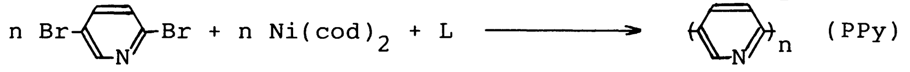
# Polarizing Film Prepared by Using Linear Poly(2,5-pyridinediyl)

Takakazu YAMAMOTO,* Tsukasa MARUYAMA, and Kenji KUBOTA†
Research Laboratory of Resources Utilization, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama 227
†College of Technology, Gumma University, Tenjincho, Kiryu 376

Stretching of poly(vinyl alcohol) film containing poly(2,5-pyridinediyl) in its surface region gives a film which shows an excellent polarizing effect at about 400 nm. Poly(2,5-pyridinediyl) with higher molecular weight gives higher polarizing effect.

Electrically conducting poly(arylene) having π-conjugation system along the polymer chain is the subject of recent interest.[1)] However, its physical and chemical properties have not been revealed enough due to its low solubility. We previously reported that poly(2,5-pyridinediyl) (PPy) was soluble in formic acid and had rigid rod-like structure in the solution as revealed by high degree of depolarization.[2)] We now report that PPy shows an excellent polarizing effect when PPy is placed on the surface of poly(vinyl alcohol) (PVA) film and the film is stretched.

PPy was prepared by the C-C coupling reaction using Ni(0)-complex, typically a mixture of bis(1,5-cyclooctadiene)nickel (Ni(cod)$_2$) and neutral ligand L.[2)]



(1)

The n value of PPy reported in our previous paper was up to 25, but we obtained PPy with n value of 49 (calculated from weight-average molecular weight determined by light scattering method) using 2,2'-bipyridine as L (yield = quantitative). The degree of deporalization ($\rho_v$) remained almost constant ($\rho_v$ = 0.33-0.31) up to n = 49. The position of $\lambda_{max}$ (372 nm) of π-π* transition in formic acid and thermal stability (estimated from TGA) of PPy essentially did not vary, either, by changing of the n value from 25 to 49.

PVA film (thickness = 70-100 μm) was painted with a formic acid solution of PPy and formic acid was removed by evaporation. It has been confirmed by IR spectra that PPy film obtained by spreading formic acid solution of PPy on glass plate and removing formic acid by natural evaporation does not contain formic acid. This PPy film and PPy molecule spread on the surface of PVA film showed $\lambda_{max}$ at the same position. The PVA film was then stretched by pulling both ends of the PVA film.

When polarized light was irradiated to the stretched PVA film, the hight of the π-π* absorption peak at $\lambda_{max}$ (400 nm) strongly dependent on the angle (θ) between the direction of electric field (E) of the polarized light and the direction of stretching of PVA. When the θ value was 0° and 90°, respectively, the two

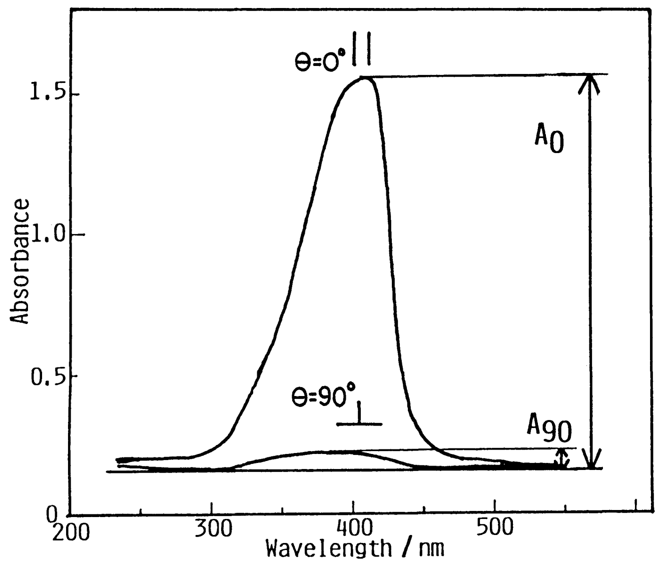


Fig. 1. Absorption of polarized light by the stretched PVA-PPy film.

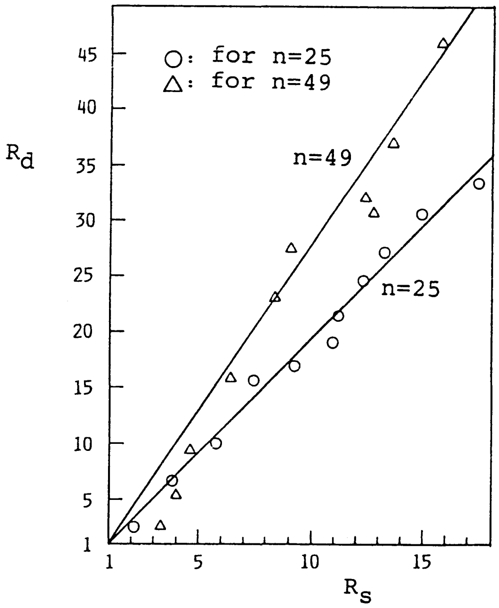


Fig. 2. Relation between $R_d$ and $R_s$ obtained with PPy with n (degree of polymerization) = 25 and 49.

absorption spectra are compared in Fig. 1. As shown in Fig. 1, a large value of absorbance ($A_0$) was obtained when $\theta = 0°$, but at $\theta = 90°$ only a very small value ($A_{90}$) was obtained. The $A_0/A_{90}$ ratio ($R_d$) obtained at 400 nm is plotted against stretching ratio ($R_s$)[3] of the PVA film in Fig. 2.

It is seen from Fig. 2, that the PVA film containing oriented PPy in the surface area serves as an excellent polarizer and the polarizing ability of the PVA-PPy film increases with increase in the molecular weight of PPy. These results agree with the large degree of depolarizability of PPy, which suggests that PPy molecule has a rod-like rigid structure with very large polarizability along one axis (presumably the direction of polymer chain) compared with those along the other two axis. Use of soluble poly(aniline),[4] instead of PPy, did not give such a polarizing film. Use of poly(arylene) as the polarizer has no precedent.

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