Liquid Crystal Magneto-Electrochemical Polymerization to Synthesize π-Conjugated Polymer Having Linear Dichroism

直線偏光二色性をもつπ共役系高分子の液晶中磁場電解合成

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Liquid crystal electro-polymerization

Chiral conjugated polymers were prepared by electrochemical polymerization of achiral monomers in a chiral liquid crystal (CLC) electrolyte solution [1,2]. The polymer films prepared in liquid crystal shows electrochromism (Fig 1), and circular dichroism. This method can be called "liquid crystal chiral electrochemical polymerization".

In this report, electrochemical polymerization of thiophene derivatives by using cholesteric liquid crystal electrolyte solution was performed. The surface morphology of the polymers was observed with scanning electron microscopy (SEM) polarizing optical microscopy (POM) observations. The polymers thus synthesized show so-called "**optically active electrochromism**". Optical rotation degree of the film is comparable with Faraday rotation of inorganic materials. The ellipticity of this polymer is also found to exhibit hysteresis with redox cycle. The optical rotation and circular dichroism of the optically active polymer can be precisely controlled through electric field by electrochemical method.

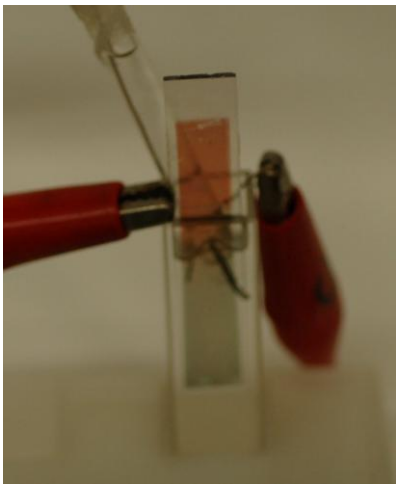

Figure 1. Electrochemical doping (oxidization) and dedoping (reduction) of the chiral polymer film in 0.1 M TBAP/acetonitrile solution.

Liquid Crystal Magneto-Electrochemical Polymerization

Magnetic field align liquid crystal in one-direction. Oriented conducting polymer film can be obtained through liquid crystal electrochemical polymerization under magnetic field. We carried out magnetic orientation with a 12 T Magnet. The polymer thus obtained in the oriented liquid crystal show uniaxial form observable with the POM (Figure 2). Polarized absorption spectra of the polymers confirmed anisotropy and "linear polarized electrochromism [2]. The conducting polymer exhibits linear dichroic electrochromism by application of external voltage.

Liquid crystal magnetic orientation in solvent evaporation process

We developed a new method of magnetic orientation in solvent evaporation process via LC state to obtain aligned polymer. Uniaxial alignment of conjugated polymer in liquid crystal was achieved under magnetic field.

Solvent in a liquid crystalline polymer solution was evaporated in a magnetic field accompanied by molecular alignment with formation of liquid crystal. A growth of the liquid crystal domains and magnetic orientation occur simultaneously in this process to form thin solid films with align liquid crystal order. This is referred to as "liquid crystal magnetic orientation in solvent evaporation process".

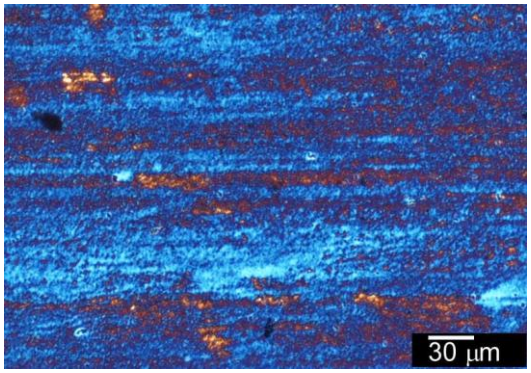

Figure 2. Polarizing optical microscopy microscopy (POM) image of the polymer prepared with liquid crystal electrochemical polymerization under magnetic field.

Reference
[1] Goto, H. *Phys. Rev. Lett.* **2007**, 98, 253901.
[2] Goto, H; Nimori, S. J. Mater. Chem., **2010**, 20, 1891–1898