Ambient Fabrication of Oriented PBTTT-based FET by FTM

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Charge carrier mobility of conjugated polymer (CP) is highly influenced by the film morphology due to its anisotropic one dimensional structure. Thus mobility can be highly improved by aligning the CP macromolecules to reduce the inter-chain and intra-chain resistances by promoting the π-π stacking. Therefore, it is of utmost importance to control the molecular self-ordering especially during or after the thin film processing for device applications. Liquid crystalline behavior in CPs such as PBTTT is effective to promote the transport performance by thermal annealing[1-3]. In order to fabricate oriented thin films of the CPs, our group has developed a novel method named as Floating Film Transfer Method (FTM)[4,5] and efforts have been directed to control the molecular orientation by optimizing casting factors[6]. In this study, we would like to utilize FTM for thin film processing of a typical thermotropic liquid crystalline (LC) CP of PBTTT aiming towards attainment of high carrier charge carrier mobility.

All of the FTM processing in this study has been carried out at 55 °C without post-annealing to its LC temperature. The orientation intensity was confirmed by the dichroic ratio (DR) of polarized electronic absorption spectra [Fig. 1(a)]. DR of PBTTT film was influenced by the casting parameters of the FTM[6]. Bottom-gate/top Au-contact type OFETs were fabricated for the electronic characterization. Fig. 1(b) shows the relationship between DR and field-effect mobility (μ). It can be seen that increase in the orientation (DR) monotonically promotes μ, thereby reaching 10^{-1} $cm^2V^{-1}s^{-1}$. It is reported that high μ in PBTTT-based FET is only obtained by the post-annealing at thermotropic LC temperature of 180°C[1-3]. One of the reasons to achieve such high μ even after processing under ambient condition could be attributed to the promotion of molecular ordering of PBTTT by its lyotropic LC characteristics while concentrating PBTTT solution during FTM.

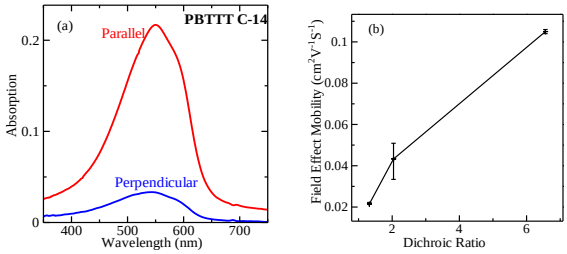

Figure 1 (a): Polarized absorption spectra of oriented PBTTT film and (b): Variation of field effect mobility with dichroic ratio.

References:

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