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Orientation factors in floating-film transfer method

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Towards the realization of organic electronics, casting the high quality thin-film is the most important key-technology with solution process. π-conjugated molecules are essential to have anisotropic electronic characteristics due to their structural feature. Thus, to control the aggregation of molecules is important for promoting the electronic performance during casting process. We have developed the orientation procedure of π-conjugated polymers by dynamic casting of floating-film and transfer method (FTM) with liquid-substrate [1]. This is cheap, easy and quick method for casting centimeter scale oriented thin-film. The orientation intensity varies with polymers, and casting condition. In this report, we have invesitgated the effect of casting conditions on the orientation intensity in FTM.

Non-regiocontrolled poly(3-hexylthiophene) (NR-PHT) was chosen as a main material for investigation in this study. Absorption spectra of thin films showed clear red-shift and two shoulders even in NR-PHT with FTM method as compared to that in spin-coated one, indicating that FTM is a casting procedure to promote the stretching and/or the ordering of polymer main-chain. Towards the improvement of the orientation intensity, we selected temperature [2], concentration ($C_{\text{NR-PHT}}$) and liquid-substrate (by changing the mixing ratio of ethylene glycol and glycerol) as possible factors. Orientation intensity was evaluated as the dichroic ratio (DR) by the ratio of the peak maximum in the absorption spectra. Figures shown below are the DR dependence on each parameter. As found, all the three factors provide a maximum DR at a certain region, indicating that the deposition condition strongly affects the alignment of polymer main-chain. Spreading speed, volatilization speed and/or solidification speed are possible to promote or interfere the orientation formation with each other. Although the detail of the orientation mechanism and procedure are still ambiguous, adjustment of the deposition condition will provide the highly oriented thin-films for each π-conjugated polymeric-semiconductors.

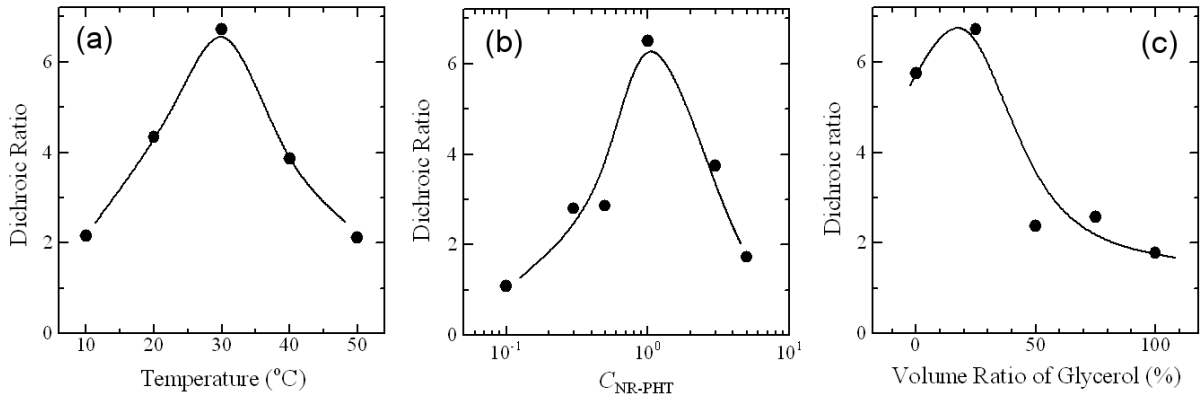

Figure: DR dependences upon (a) Temperature, (b) Concentration and (c) Glycerol ratio in liquid-substrate

References

[1] A. Dauendorffer, et.al., Appl. Phys. Exp., **5** (2012) 092101.

[2] A. Dauendorffer, et.al., Trans. Mat. Res. Soc. Jpn., **38** (2013) 305-308.