Synthesis of Photoconductive Polymer for use as the Host Material in Photorefractive Devices

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Since the discovery of nonlinear optics in 20th century, there have been a wide range of applications by involving photonics as sensing technique. In particular, the utilization of photorefractive effect for sensing shows huge potential in deep detection and imaging because it could be approached without treatment of invasive media or destructive operation, such as photoacoustic and high resolution holographic tomographies [1]. In general, there are mainly three components in amorphous polymer based PR devices, including organic electro-optic chromophore, sensitizer and the host material. The use of main chain conductive polymer as host material in PR composite could provide attractive performance because their outstanding hole mobility would fit the requirement for charge transporting. However, without the addition of plasticizing group, the composite would lose the softness and provide high glass transition temperature (T_g), causing the difficulty for chromophore orientating so that the large external electric field (E_{ex}) should be required to satisfying the performance. Moreover, the fabrication of device would also be challenged as a result of the high T_g. As a consequence, it is essential to introduce the plasticizing elements into polymer matrix to enhance the flexibility for both device assembling and performance [2].

In this work, we present the synthesis of main chain conducting polymers with bulky side group for both functions of plasticizing and hole transporting. These materials were compounded through palladium catalyst and purified by Soxhlet extraction and silica-gel column chromatography to obtain the high purity grade of polymeric products. With excellent compatibility of organic DCST based chromophore in 30% loading and 1% loading of PCBM, the polymer thin films were prepared with good optical transparency. By applying the external electric field, the devices performance was estimated through the optical four waves mixing (FWM) technique. The result shows that under E_{ex} = 35 V μm^{-1} of mild condition, the diffraction efficiency (η) could be observed by 0.3% with the fast response time constant (τ) at 2 *m*s and the change of refractive index (Δn) approaching to 4×10^{-4}.

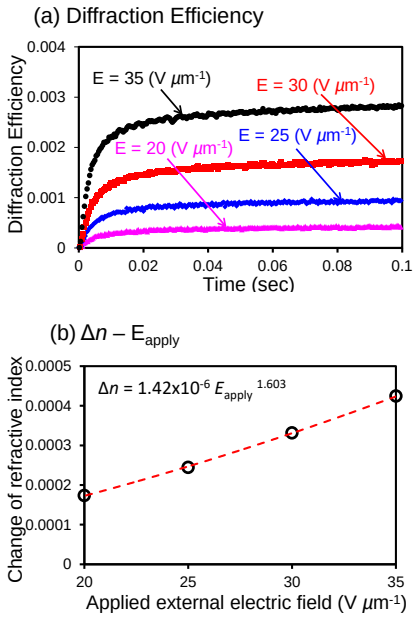

Fig. 1. FWM result. The thickness of devices was 32 μm. (a) Diffraction efficiency. (b) Summary of the relationship between Δn and E_{ex}.

Reference

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