Precisely controlled phase separation for highly efficient organic photovoltaics
高効率有機太陽電池作製のための相分離構造の精密制御
AIST¹, JST-PRESTO²  Zhiping Wang¹, Tetsuhiko Miyadera¹,², Yosei Shibata¹, Toshihiro Yamanari¹, Yuji Yoshida¹
産総研 ¹, JSTさきがけ² 王 植平¹, 宮寺 哲彦¹,², 柴田 陽生¹, 山成 敏広¹, 吉田 郵司¹
E-mail: wang-zhiping@aist.go.jp

Phase separation is one of the state-of-the-art strategies to achieve highly efficient organic photovoltaic cells (OPVs). Ideal phase separated structure requires an interpenetrating network of the donor–acceptor blend, which offers large interfacial area for efficient charge separation and excellent charge transport, leading to high efficiency performance [1]. However, most of the small-molecule based donors used to date showed featureless morphology when co-evaporated with fullerene (C₆₀), which make it very difficult to realize precise control of phase separation.

In this study, we report a novel method to achieve clearly featured morphologies and precise control of phase separation in the zinc phthalocyanine (ZnPc):C₆₀ co-evaporated film by controlling the crystal growth of ZnPc films on the well-crystalized 2,5-bis(4-biphenylyl)-bithiophene (BP2T) layer. P-i-n type structured OPV devices were fabricated to examine the photovoltaic performance. On the crystalline BP2T layer, clear phase separated morphology of ZnPc:C₆₀ blend layer was observed [Fig. 1(a)]. The different interaction strength among ZnPc, C₆₀ and BP2T is speculated to promote the selective growth model, leading to the phase separated morphology [Fig. 1(b)]. This phase separated structure greatly improved the charge separation and charge transport, resulting in a high power conversion efficiency of 4.15%.


Acknowledgement: We thank JST-PRESTO for the financial support.