Naphthobisthiadiazole-triphenylenobisthiadiazole Random Copolymers for Non-Fullerene Solar Cells

Li-Hui Chou[1], Tsubasa Mikie[1], Masahiko Saito[1], Fengkun Chen[2], Kyohei Nakano[2], Keisuke Tajima[2], Itaru Osaka[1]
[1]Graduate School of Advanced Science and Engineering, Hiroshima University
[2]RIKEN Center for Emergent Matter Science (CEMS)
E-mail: iosaka@hiroshima-u.ac.jp

Introduction

Semiconducting polymers have attracted great attention in the field of organic electronics because of the good optoelectronic properties and solution processability. We have reported that a naphthobisthiadiazole (NTz)-based semiconducting polymer (PNTz4T) exhibited a relatively small bandgap and highly crystalline structure, which led to high performance in fullerene-based solar cells.[1)] However, PNTz4T had relatively low solubility, which hampered solution processability, due to its high crystallinity. In this study, a series of NTz-based random copolymers incorporating small amount of triphenylenobisthiadiazole (TPTz)[2)] with different alkyl sidechain were designed and synthesized (Figure 1). We expected that introduction of TPTz having a V-shaped structure would increase the solubility of the polymer while preserving the crystallinity. The impact of introducing the TPTz core unit on the energetics, film structures, and photovoltaic performances in the solar cells are investigated.

Results

As expected, the random copolymers exhibited significantly increased solubility compared to PNTz4T. The polymers showed absorption spectra in the range of 500–800 nm, thus gave optical bandgaps of around 1.55 eV, which were similar to PNTz4T. Interestingly, introduction of TPTz unit turned the molecular ordering to face-on orientation. The PNTz4T-A3C12-5% showed a PCE of 10.8%, which was the highest value among the polymers synthesized here and was higher than PNTz4T. We will discuss the structure-property relationships of the random copolymers in comparison with PNTz4T in more details.

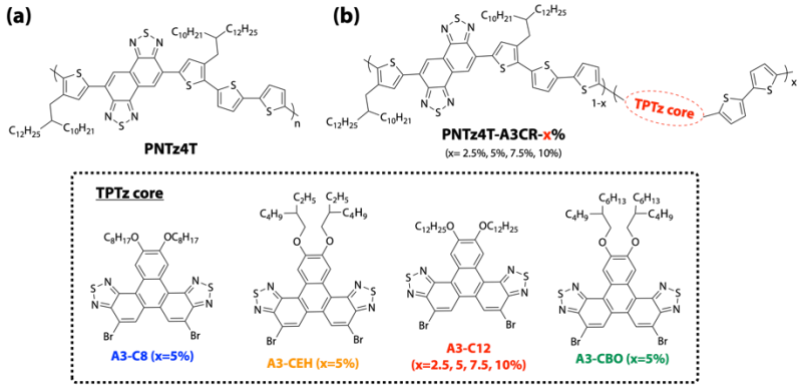

Figure 1. Chemical structure of (a) PNTz4T and (b) NTz-TPTz random copolymers.

References

1) I. Osaka, et al., *Nat. Photon.*, **2015**, *9*, 425. 2) K. Tajima, et al., *ACS Appl. Mater. Interfaces* **2021**, *13*, 57743.