Alkyl substitutions a powerful tool for tailormade properties of soluble and versatile organic semiconducting materials

Jozef Krajcovic(krajcovic@fch.vut.cz)[1], Alexander Kovalenko[1], Cigdem Yumusak[2]
Niyazi Serdar Sariciftci[2]
[1]Brno University of Technology, Faculty of Chemistry, Brno, Czech Republic, [2]Linz Institute for Organic Solar Cells (LIOS), Johannes Kepler University Linz, Austria

Abstract

Nowadays many organic semiconductors have been developed to improve the device performance, where most of the efforts focused on the design and synthesis of new π-conjugated backbones [1]. However, much less efforts have been devoted to understanding the role of the side chains of organic semiconductors. Alkyl chains, oligo (ethylene glycol) chains, and fluoroalkyl chains are three commonly used side chains in organic semiconductors. These side chains generally do not directly contribute to charge transport in organic semiconductors and are usually used as solubilizing groups.

Adamantane is the simplest diamondoid and possesses exceptional physical properties. Moreover, adamantane is more stable saturated hydrocarbon isomer of such a small molecular weight.

Ethyl-adamantyl side groups substituted on to para-bis(2-thienyl)phenylene, a solid-state fluorescent dye, were found to induce π–π interactions between the conjugated para-bis(2-thienyl)phenylene cores. At the same time, stacking between the central unit and the adamantyl-containing side group was observed. As a result, due to steric hindrance augmentation of the solid-state, luminescence was observed. Moreover, substitution of standard alkyl side chains with ethyl-adamantyl groups resulted in raising the melting point temperature from 55 °C to 250 °C [2].

Novel ethyladamantyl solubilization side groups were found as adamantyl–adamantyl stacking in soluble diketopyrrolopyrrole (DPP) derivatives. Due to high crystallinity and co-planarity electron transfer was preserved with a mobility of 0.2 cm2/(V s) for dithiophene-DPP [3].

Keywords: *organic semiconductors, alkyl side chains, Adamantane, diketopyrrolopyrrole*

References

[1] [1] C. Wang, H. Dong, W. Hu, Y. Liu, D. Zhu, Chem. Rev. 112 (2012) 2208

[2] [2] J. Krajčovič, A. Kovalenko, P. Heinrichova, M. Vala, M. Weiter, Journal of Luminiscence. 167 (2016) 222

[3] [3] A. Kovalenko, C. Yumusak, P. Heinrichova, S. Stritesky, L. Fekete, M. Vala, M. Weiter, N.S. Sariciftci, J. Krajčovič, J.Mat.Chem. C. 5 (2017) 4716

Biography