Spectrally selective single-component organic photodetectors based on donor-acceptor conjugated molecules

A.L. Mannanov [1,2*], ***D.O. Balakirev***[1], ***N.K. Kalinichenko***[1], ***A.N. Solodukhin***[1], ***Yu.N. Luponosov***[1], ***D.Yu. Paraschuk***[1,2], ***S.A. Ponomarenko***[1]

[1]Enikolopov Institute of Synthetic Polymeric Materials of the Russian Academy of Sciences
[2]Faculty of Physics, Lomonosov Moscow State University
*e-mail: artur.mannanov@ispm.ru

Photodetectors based on organic materials are attractive due to their tunable spectral response, flexibility, ease of manufacturing and biocompatibility, so they can become the basis for creating an artificial human eye[1]. Therefore, the development of narrowband spectrally selective organic photodetectors is of increased interest. One of the approaches to the creation of narrowband photodetectors is the use of a photoactive layer of a single donor-acceptor material with a narrow absorption spectrum, in which effective charge generation can occur. Single-component organic photodetectors also attract attention for their simplicity, especially in light of their possible biological applications. Donor-acceptor (D-A) conjugated molecules are among the most promising architectures for use as a photoactive material in organic solar cells and photodetectors. The wide possibilities of variation of the chemical structure of D-A conjugated molecules allow fine-tuning the properties of the materials obtained[2,3]. Materials with a suitable optical absorption spectrum and sufficiently high efficiency in single-component solar cells were selected from a huge library of previously synthesized molecules. Based on the most promising materials (Fig. 1), prototypes of single-component organic photodetectors were fabricated and characterized. These photodetectors demonstrated a sufficiently high responsivity and spectral selectivity comparable to those of cones and rods of the human eye. It has been shown that the response time of photodetectors based on the selected semiconductors is three orders of magnitude lower than the response time of photoreceptors in the human eye. The results obtained demonstrate the possibility of creating an artificial eye - a matrix of organic photodetectors with different spectral sensitivity, or photoactive "prostheses" for an eye devoid of sensitivity to light due to certain diseases.

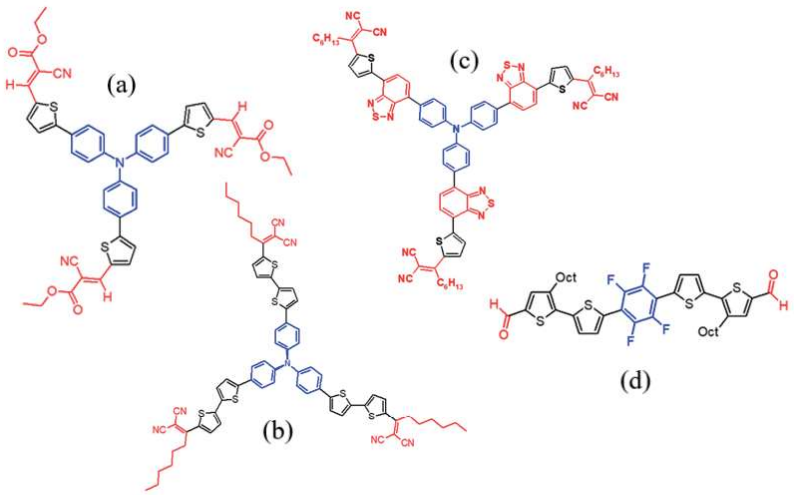

Fig. 1. Chemical structures of molecules that mimic human photoreceptors: a) rods, b) green-sensitive cones, c) red-sensitive cones and d) blue-sensitive cones.

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[2] Y.N. Luponosov et al. *Materials Today Energy.* 2021, 100863.
[3] A.N. Solodukhin et al. *Energies*. 14, 2021, 3596.