Organic bulk heterojunction photovoltaics and photodetectors

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Organic photodiodes are the class of light detectors which are now intensively investigated with an aim for applications in existing imaging technology, optical communication, wearable electronics (e.g. medical sensors) and environmental monitoring. Organic semiconductors are an interesting group of electronic materials because they combine some of the features of classical semiconductors with advantageous chemical and physical properties typical of organic materials, in particular polymers.

We investigated organic, bulk heterojunction, characterized with unbalanced charge carrier mobilities, for application in photovoltaics and photodetectors

The presented drift-diffusion simulation of bulk heterojunction photodiodes with Langevin recombination indicates that the bandwidth of photodiode is approximately independent of the mobility of slower charge carriers in the blend. The negative effect of low mobility on the responsivity can be compensated by increasing the reverse bias. Our study shows that well performing organic photodetectors can be fabricated using organic semiconductors having too low mobility for photovoltaic applications. Moreover the simple device structure allows to fabricate the devices with fast time response.

In the case of the photodetectors designed for NIR spectral range the reversed device structure might significantly reduce the level of the dark current what results in high responsivity and detectivity of such devices.