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Current Trends in Organic Chemistry Existing in Organic Solar Cells

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Organic optoelectronic devices including Organic Light Emitting Diodes (OLEDs), Organic Field Effect Transistors (OFETs), Organic Liquid Crystals (OLCs) and Organic Solar Cells (OSCs) are wide investigated during the past 40 years regarding their potential for commercial application. A variety of innovative organic materials, including semiconducting polymers, small compounds or dendrimers are synthesized for their practical used in devices. Among various organic devices special attention is dedicated during the last ten years to organic solar cells including photovoltaic devices 3rd and 4th generations. Third generation of photovoltaic devices including organic and polymeric PV and dye sensitized solar cells (DSSC), while fourth generation of PV devices, investigated presently as the most promising for the practical applications, including organic PV with various plasmonic nanoparticles such as graphene, graphene oxide, carbon nanotubes, quantum dots, metal nanoparticles, ZnO, TiO_x, MoO_3, or V_2O_6.

Use of the organic materials is supposed to be very promising in photovoltaic devices because of low cost, flexibility, transparency low light-suitability and disposability. Moreover, for the polymer (and small compounds) solar cells various chemical structures of polymers are synthesized and tested.

Presently, organic solar cells are wide investigated in few main directions: (i) application of new polymers, copolymers or small compounds in active layer of PV devices, (ii) application of graphene, graphene oxide and their chemical modifications, carbon nanotubes, fullerenes and their derivatieves in active layer or as an interlayer in PV devices, (iii) application of new polymers or graphene as a flexible substrate in PV devices and (iv) application of new polymers as buffer layer instead of PEDOT:PSS in OSCs.

Considering the polymer structure used as an active layer in the construction of polymeric photovoltaic devices, poly(3-hexylthiophene) (P3HT) and their derivatives have primarily been investigated as a donor material. Among the other polymers that have been investigated in organic photovoltaics, polymers and copolymers with benzothiadiazoles, carbazoles, phenylenevinylenes or azomethines units are examined. In bulk heterojunction (BHJ) devices, [6,6]-phenyl-C_{61}-butyric acid methyl ester (PCBM) and [6,6]-phenyl C_{70}-butyric acid methyl ester ($PC_{70}BM$) are mainly used as an acceptor.

As of today, there are several notable examples that value of power conversion efficiency (PCE) of OSCs increase during the last few years. In 2010 the PCE value of OSCs increases from 5.1 to 8.3%, in 2011 to 10%, in 2012 to 12% and in 2013 to 15%. The theoretical works from 2008 have predicted "realistically achievable" PCE values of *ca.* 15% for fully optimised donor-acceptor BHJ organic solar cells.

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