Design of fullerene-based acceptor materials for organic solar cells

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Organic solar cells can be fabricated on plastic foils using high throughput printing techniques [1]. In comparison with conventional silicon cells organic photovoltaics allows for flexible substrates and low cost production [2].

Here we report on our efforts in designing novel acceptor materials based on fullerenes and their application in organic solar cells. The following major issues will be addressed in the presentation.

1. We have developed an efficient method for production of highly soluble fullerene derivatives with appended chelating pyridyl units [3]. This type of fullerene compounds enabled a "smart" bilayer solar cell architecture where donor and acceptor counterparts are forming complexes at the interphase between the layers. This metal-organic complexing facilitates photoinduced charge separation and improves overall performance of the device [4].

2. A large family of highly soluble methanofullerenes was synthesized and extensively characterised. These compounds are represented by esters of Phenyl-C_{71}-Propionic and Thienyl-C_{61}-Propionic acids. Newly prepared materials were investigated in bulk heterojunction solar cells in combination with the polyconjugated polymers MDMO-PPV and P3HT. Power conversion efficiencies of 3.0-3.9% were obtained for the best material combinations. A correlation between molecular structure, active layer morphology and solar cell performance will be presented.

3. For better light harvesting in organic solar cells, we suggest device architecture, called "multicomponent" solar cell. The active layer of these cells comprises a zinc phthalocyanine layer with a fullerene/polymer bulk heterojunction layer spin-coated on top. The resulting solar cells generate photocurrent from 350 to 830 nm with appreciably high power conversion efficiencies [5].

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