Polymer materials for organic photovoltaics

Hartmut Krueger, Silvia Janietz

Fraunhofer Institute Applied Materials Research, Geiselbergstrasse 69, 14469 Potsdam-Golm, Germany, phone: +49 331 568-1920 or –1208, fax: +49 331 568-3910, email: krueger@iap.fhg.de or janietz@iap.fhg.de , http://www.iap.fraunhofer.de/fb2/elektronik.html

Our department of "Polymers and Electronics" of the Fraunhofer Institute for Applied Polymer Research (IAP) works in the fields of polytronics, light-emitting polymers for OLEDs and organic photovoltaics for about 10 years. We are specialized in the development of active organic materials for these applications. These activities include the synthesis of new polymer materials with special properties, their chemical, electrochemical and spectroscopic characterization. The physical properties of the new materials can also examined basically in devices.
In the field of OLEDs our focus is spent on the development of non-conjugated phosphorescent solution-processable PLEDs with covalently attached charge transport units and transition metal complexes. In organic electronics we are working on new more airstable polymers and on crosslinkable dielectrics adapted to the active materials.
During the last 5 years the group has been engaged in the field of polymer blends of n- and p-type semiconducting materials for organic photovoltaics. Therefore some new organic materials with strong acceptor properties were synthesized and first polymer blends were applied in solar cells. The improvement of the cell performance by higher electron mobility and optimised blend structure is a field of current group activities. In this way blockcopolymers with defined block lengths of the donor and acceptor monomers were synthesized. As n-type semi-conducting monomers quinolines and as p-type 3-hexylthiophenes were used. Blockcopolymers are known to form well ordered phase separation structures.
For a better light harvesting of the longer wavelength range we developed a range of different copolyfluorenes with tuneable bandgap and energy levels (Figure 1). A special attention was spent to increase molecular weights and solubility of these polymers.

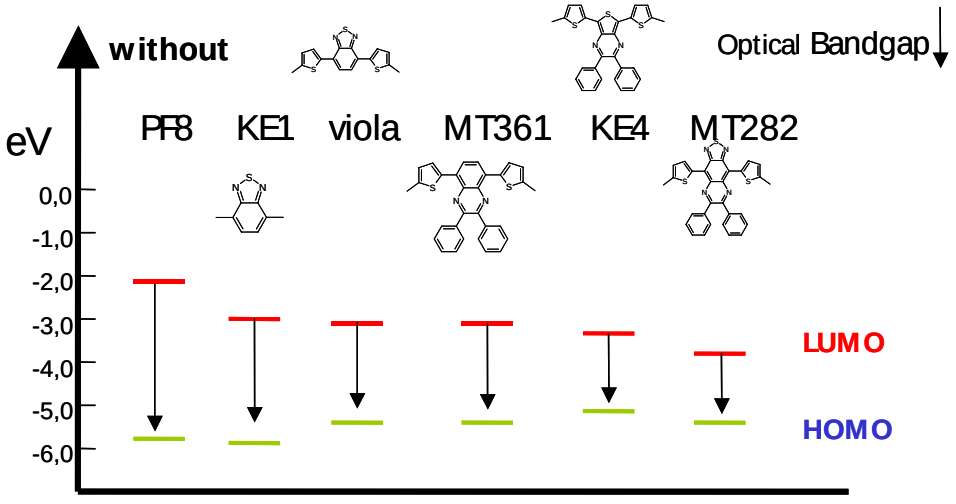

Fig. 1: Overview of tunable bandgap (3,6 to 1,3 eV) and energy levels of copolyfluorens in regard to the used comonomer to enable adaption to acceptor

Additionally we are developing new organo-soluble conjugated polymers with strong acceptor units like 1,3,4-heterodiazoles, quinolines or quinoxalines and dialkoxy substituted phenylene and/or dialkylfluorene units in the main chain. The know-how to synthesize regioregular poly(3-alkylthiophenes) with special grade for electronic applications is also available in our lab. We have excellent experience in the prior-characterization of the new synthesized organic materials with cyclovoltammetric measurements.
Beside well equipped synthesis labs a wide range of characterization methods (spectroscopy, cyclovoltammetry, photoelectron spectroscopy, TEM, REM, AFM, XPS) and clean-room facilities (incl. glove boxes) are available.