Thiophene-based solution-processable organic semiconductors for optoelectronic applications

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Organic electronics is a fast-growing field of science and technology, leading to creation of novel energy efficient, light weight and flexible devices, based on organic light emitting diodes (OLEDs), organic field effect transistors (OFETs) and organic photovoltaic cells. Fast progress of organic electronics depends on the availability of highly efficient solution-processable organic semiconductors. Thiophene-based materials among them play an important role for various optoelectronic applications. In this presentation, our resent results on design, synthesis and application of several classes of soluble organic semiconducting materials based on thiophene chemistry will be reported.

Amoung them are rather simple linear thiophene-phenylene co-oligomers with trimethylsilyl donor or trifluoromethyl acceptor groups, which were found to form large single crystals with molecularly smooth surfaces by the growth from solution.[1] They showed not only good field effect mobility, but also efficient luminescence in the solid state making them promising candidates for creation of organic light emitting transistors and organic injection lasers. More complex branched oligoarylsilanes, consisting of two types of conjugated oligomers connected to each other through silicon atoms, which brake the conjugation, possess very efficient intramolecular energy transfer, huge absorption cross-section and high luminescence quantum yields up to 96%.[2,3] They can be made compatible with various polymer matrixes, like polystyrene, PMMA, polyfluorene or even polysiloxanes, and used in different optoelectronic applications, like OLEDs or plastic scintillators as highly efficient wavelengths shifters with tunable optical properties. Linear or branched oligomers with alkyldicyanovinyl acceptor end groups and various central donor groups were successfully synthesized and applied as donor materials in organic photovoltaic devices, where power conversion efficiency exceeding 5% can be achieved.[4,5]

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References:

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