New anthraquinone-based donor-acceptor organic semiconductors: synthesis, structural, spectroscopic and electrochemical characterization and application in organic electronics

Modern synthetic chemistry is a powerful tool for the preparation of new organic semiconductors of tunable electronic, spectroscopic and electrochemical properties. Appropriate functionalization may render these materials soluble which upon controlled processing are able to form thin active layers of ordered supramolecular organization. This solution processability is technologically advantageous over evaporation techniques, predominantly used in thin organic films deposition. These peculiar properties of organic semiconductors of the newest generation have been successfully exploited in display and lighting technologies, for example as components of organic light emitting diodes (**OLEDs**). However, there still exist problems in organic semiconductor technology which somehow impede its further progress. The main important are: i) limited number of semiconductors of high electron affinity (**EA**), values which assure improved stability in operating conditions; and ii) even lower number of semiconductors of low band gap, high **EA** and appropriate ionization potential which could be used as red and near infrared emitters.

The main goal of this proposal is to contribute to the resolution of the above formulated problems. In particular, we propose to synthesize new low molecular mass semiconductors of the following structural sequence: donor-linker-acceptor-linker-donor. Special structure of the acceptor unit should be pointed out, it will consist of three segments: a central anthraquinone-type acceptor symmetrically connected to two auxiliary acceptors. This central unit will be capped with linkers containing reactive groups to which donor units can be attached via an appropriate C-C coupling reaction. By changing the chemical structure of the central acceptor unit or by modifying its geometry we plan to prepare a series of semiconductors of tunable properties. Obtained compounds will be characterized by structural, electrochemical, spectroelectrochemical and spectroscopic means with special emphasis on their electroluminescent properties. The obtained experimental data will be confronted with the results of theoretical calculations, giving in the future better tool for designing new semiconductors exhibiting predicted properties.

The obtained semiconductors of band gaps inferior to 2.0 eV will be tested as red and infrared emitters in organic **LEDs**. Special interest will be focused on semiconductors exhibiting the thermally activated delayed fluorescence (**TADF**) effect, which provide better quantum efficiency of diodes, based on them. In addition, synthesized semiconductors of the proper electronic properties will be used to fabricate ambipolar field effect transistors (**FETs**).

To summarize, the main goal of the proposed research is to explore new possibilities in the synthesis of organic semiconductors, especially those which can be used as active layers in ambipolar **FET**s, and **TADF** red and infrared emitters. The latter are of special importance in biomedical and data transmission applications.