Project 3.2 Structurally tuned and nanostructured polymers conducting in both the positive and negative potential range as electrode materials for supercapacitors

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Background:

The ongoing interests in the fabrication of polymer-based materials suitable for application as electroactive materials for electrodes of electrochemical capacitors (ECs), also known as supercapacitors (SC) or ultracapacitors (UC), are mainly focused on conducting polymer materials with a limited maximum of operating voltage. Currently, available SC devices reveal several favorable properties, including a long lifetime during charging and discharging and broad operating temperature ranges. Therefore, their use has become widespread in intelligent energy networks (smart grids), aircraft, and electrical vehicles. However, compared to batteries, they still face some challenges in terms of low energy density. New SC electrode materials with ambipolar nature, i.e., indicating electrochemical activity in both the positive and negative potential range, should provide conductivity extending over a very wide voltage range. This property is highly desirable for devising and fabricating novel energy storage materials with high capacity and energy density. Conducting ambipolar polymers are electroactive in both the negative and positive potential range. This unique ambipolarity of a conducting electrode material introduces the desired high operation voltage to the SC device. Favorable structures of ambipolar polymers containing conducting donor units conjugated with conducting acceptor units are responsible for enhanced charge conduction in a broad potential range. Hence, they are very promising for the preparation of high-performance SCs in terms of energy high density and power density. Therefore, studies of their stability under the applied potential conditions are essential for understanding the mechanism of their operation and then improving their electrochemical properties.

Aim:

The ultimate goal of the proposed research is to develop a durable supercapacitor with excellent specific capacitance and high power and energy density based on structurally tuned alternating DAD ambipolar polymers.

Requirements:

- Master's degree in Chemistry
- preferable experience in organic synthesis, UV-Vis-NIRspectroscopy, and electrochemistry,
- a positive result of the qualification interview for the international Doctoral Studies at IPC PAS,
- high motivation for scientific research.