

Development of electronic requires an extension of the research field of useful materials on potentially applicable organic conductors and semiconductors. Such materials need have properties comparable or better in comparison with those of conventional inorganic ones. Besides, they should be easily tunable to the desired parameters and conditions. For that reason conducting materials, their synthesis and comprehensive characterization is currently one of the main research topics of chemistry.

The core aim of the project is synthesis and characterization of the novel complex systems consisting of norcorrole or its derivatives as building blocks. Norcorrole is a condensed macrocyclic tetrapyrrole consisting of two bipyrrrole moieties linked by arylmethine bridge with delocalized [16] $\pi$ -electron system determining antiaromatic character of this porphyrinoid. A consequence of such an electronic structure is significant alteration of redox properties of norcorrole in comparison with aromatic macrocycles such as porphyrins or corroles, i.e. decrease of oxidation potentials and increase of reduction potentials. Thus, norcorroles are both better donors and acceptors than aromatic macrocycles, which makes them potentially attractive candidates for organic conducting materials. Moreover, norcorrole can be obtained as metal complexes with high yield and on a gram-scale by metal-templated annulation of properly activated dipyrins. An advantageous feature of norcorrole ring is regioselective reactivity of  $\beta$ -pyrrole positions towards substitution reaction which allow facile modifications and fine-tuning of its spectroscopic or redox properties.

Distinct features of the systems explored within this project will be the presence of more than one redox-active center. The main task will be to explore communication between the subunits of these centers via delocalization of the electron/spin density or electrostatic interactions. Their ability to create more complex structures through covalent bonding, metal ion coordination or other type self-assembling will be explored as well. The planned syntheses will involve various types of extension of the system, including oligomers in which the subunits are connected by one or more covalent bonds, through the coordination of two or more subunits to one metal ion, and such compounds, where both of these ways of linking occur together. Special attention will be dedicated to the redox properties of the obtained systems. The effects of various structural features occurring in the subunits, such as the donor-acceptor or steric properties of substituents, on the redox potentials, HOMO-LUMO energy gap, and communication between the redox centers will be examined.

Three types of systems will be explored: 1) norcorroles with redox-inactive metal ion within the macrocyclic crevice ( $\text{Ni}^{\text{II}}$ ,  $\text{Pd}^{2+}$ ) with redox-active substituents at the *meso*-positions of the macrocycle, such as ferrocene or polycyclic hydrocarbons, 2) covalently linked dimeric systems with a direct single or double bonding between subunits as well as oligomers with fused aromatic pyridine ring as a bridge, and 3) oligomers with metal-ion bridge coordinated to the donor sites introduced to the monomeric or dimeric units. Among the systems with pyridine bridge there will be systems with other types of redox-active centers, e.g. porphyrins, dipyrins, or polycyclic hydrocarbons.

Apart from spectroscopic and electrochemical characterization of these new systems, attempts will be made to characterize products of one- and multi-electron oxidation and/or reduction these new systems, in order to recognize their spin state and magnetic properties.

Variety of spectroscopic methods will be used for characterization of the new systems, including multinuclear NMR, UV-vis-NIR, EPR, and CD. The leading non-spectroscopic technique in this project will be electrochemical method (cyclic and pulse voltammetry). The experimental results will be analyzed by theoretical calculations on the DFT level.

The project is expected to supply new knowledge regarding reactivity of antiaromatic compounds as well as aromatic/antiaromatic assemblies, in particular, redox properties of these systems. Apart from the purely scientific importance, the results may have some applicable character as well.