Advanced functional materials from organic paramagnetic building blocks

This research project deals with two unusual classes of organic compounds both derived from exceptionally stable radical **A** shown in Figure 1.

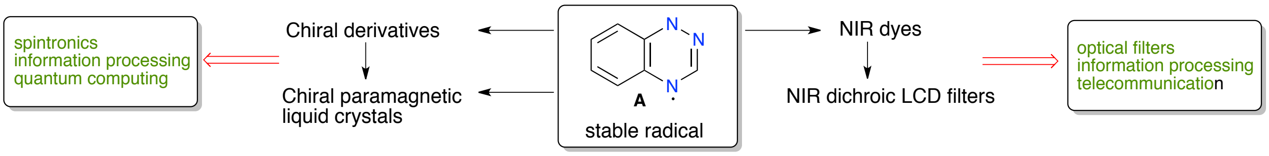

Figure 1. 1,4-Dihydrobenzo[*e*][1,2,4]triazin-4-yl (**A**) as the key structural element of two classes of functional materials.

The first group of materials combines chirality with magnetism, two truly fascinating and fundamental scientific phenomena. Materials designed for this project are synthesized and investigated for chiro-magnetic properties and electron transmission in the context of emerging technologies of information storage and information processing, which use devices built from individual molecules. Such technologies are important steps towards quantum computers, the next generation of highly efficient devices.

The second group of materials is specifically designed to address the current needs of telecommunication industry. These organic compounds are envisioned to be part of liquid crystalline electro-optical devices acting as filters in processing of optical signals in the near infrared region of the telecommunication spectrum. Development of such materials is dictated by continuously increasing demand for faster and more efficient information processing using optical fibers rather than metal wires. For instance, replacing of wiring in airplanes with optical waveguides would eliminate 900 kg weight in the popular Airbus A320. Also, faster data processing is of crucial importance for the increasingly autonomous cars.

This research project is multidisciplinary, represents a combination of experiment and theory, and involves extensive investigation of structure-property relationships using physical-organic and physics research tools. The general methodology used in this project includes organic synthesis, chemical, spectroscopic, chiro-optical, thermal, electrochemical and electro-optical characterization, and computational analysis, which will be performed at the CMMS–PAS. In addition, specialized analyses, such as chiro-magnetic, magnetization studies, surface characterization (including electron and spin transport), single crystal and powder XRD measurements and solid-state photoconductivity, will be performed through established collaborations.

Another aspect of the proposed research program is concerned with training of modern scientific workforce in an interdisciplinary, collaborative, and international environment.