Chiral diradicals: Paramagnetic building blocks for advanced materials

Magnetism, typically associated with certain metals and minerals, is one of the most fundamental natural phenomena, and is indispensible for modern technologies ranging from a simple compass to information storage and processing devices. It originates from properties of an unpaired electron and its cooperative interactions with other unpaired electrons. In organic compounds Nature prefers pairing of electrons and those with unpaired electron - organic radicals - typically are highly reactive. There is only a very small group of stable organic compounds with unpaired electrons – stable organic radicals – and their magnetic properties are truly fascinating with a vast potential for technological applications. In this project we connect two exceptionally stable radicals ***BT*** or ***FBT*** (Figure 1) to a chiral molecular platform and investigate an unusual class of organic magnetic materials.

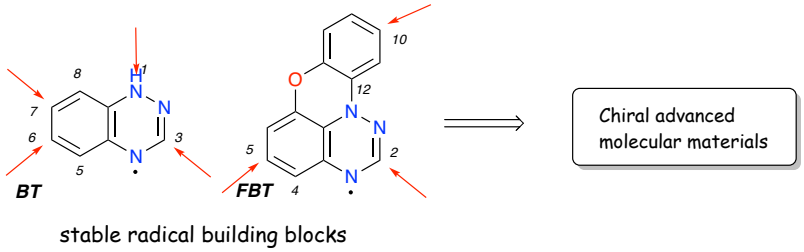

Figure 1. Structures of stable paramagnetic structural elements ***BT*** and ***FBT***. The dot represents an unpaired electron and the arrows connecting sites to chiral scaffolds.

The proposed materials combine chirality with magnetism, two amazing and fundamental scientific phenomena with vast technological potentials. Materials designed for this project are synthesized and investigated for chiro-magnetic properties and electron communication in the context of emerging technologies of information storage and information processing.

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, and electrochemical characterization, augmented with computational analysis, which will be performed at the CBMM PAN. In addition, specialized analyses, such as chiro-magnetic, magnetization studies, surface characterization and single crystal XRD measurements, will be performed through established collaborations.

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