Towards novel ZnO quantum dots coated with mixed-ligand shell

The intensive development of nanotechnology has occurred in the last two decades due to many pioneering works in the field of basic and application research. Nanomaterials, such as objects whose dimensions are on a scale of 10^{-9}, are more and more applied in areas such as electronics and medicine. Nanostructured materials find a wider and wider application in a wide range of everyday products ranging from deodorants and ending up with clothing. In recent years, numerous studies have been conducted on the use of nanoparticle structures in the context of targeted drug carriers, e.g. anti-cancer drugs and as very sensitive bioanalytical tools. These practices are aimed at revolutionizing the existing methods of biomedical research and broadly understood clinical practice. The current growing interest in QD technology is stipulated by the potential applications of quantum dots in many areas of science. Quantum dots (QDs) are characterized by unique photophysical properties (namely their size-dependent spectrum properties, high photostability, narrow light emission spectrum together with efficient light absorption spectrum) and the possibility of surface modification, which gave rise to the broadening of various *in vitro* and *in vivo* tests. An additional advantage of these nanosystems is the fact that they have a relatively small size compared to typical biomolecules (e.g. proteins).

The main goal of the project is *(i)* to develop an efficient path for the synthesis of alkylzinc mixed-ligand complexes and their characterization by spectroscopic methods, *(ii)* to use the obtained complexes as precursors in the synthesis of ZnO nanocrystals, and finally a complete characterization of the obtained nanosystems. In recent years our research group has shed new light on the issue of the organometallic method of synthesis of nanometric zinc oxide forms, proving that ZnO NCs can be obtained in a controlled manner by hydrolysis and oxidation of properly designed metal centers, which leads to nanocrystals of a certain size, stabilized by an organic shell.

Planned studies should provide comprehensive information both on *(i)* basic interactions stabilizing alkyl-zinc hetero-ligands complexes, as well as *(ii)* the possibility of their use as precursors in the organometallic path of obtain nanomaterials based on zinc oxide, and *(iii)* physicochemical properties of advanced hybrid materials. A characteristic feature of the planned research is to use of “bottom-up” strategies, which allow control over the formation of materials by hierarchically organizing nanostructured building blocks to supramolecular systems using interactions at the molecular level. Thus, the presented project gives the opportunity to recognize the mutual relationships between the structure and the reactivity of alkyl zinc hetero-ligands complexes, and the structure and physicochemical properties of obtained self-assembly nanomaterials. This underlines the extremely interdisciplinary and innovative nature of the project, which opens up new possibilities in the synthesis of new hybrid inorganic-organic materials.