Dynamic self-assembly of ZnO nanoparticles into supramolecular organic-inorganic materials

The observed fast development of technology touches almost each area of our professional and everyday live providing new ways for communications, extremely effective data storage systems, new medical strategies and smart devices we can use when and where we need. Most of these achievements are the result of usage of novel (nano)materials which are designed and constructed in chemical laboratories. Among the state-of-the-art materials, hybrid inorganic-organic systems are of particular interest while they combine all advantages known for classical organic and inorganic compounds as well as can provide totally new properties, which can be beneficial for the current technologies. The most promising way to achieve such complex systems are self-assembly processes by which the individual chemical entities organize step-by-step into more complex matter (called supramolecular systems) via weak and specific interactions.

The main goal of the project comprises the development of supramolecular systems based on ZnO nanoparticles (one of the most promising semiconducting material widely used in electronics, photovoltaics and catalysis) and their subsequent use in the reversible, controlled assembly of complex organic-inorganic architectures in aqueous media. This will be accomplished by employing cucurbit[*n*]urils (CB[*n*]s) as one of the most promising self-assembly motifs that can act as molecular "handcuffs" able to bind two various chemical entities leading in this way to more complex systems.

The initiatives of the project encompass problems across the fields of basic host-quest interactions including molecular recognition, self-assembly processes, and materials science, as well as interface and colloid chemistry. A characteristic feature of the planned research is utilization of ZnO nanoparticulate building blocks to the formation of self-organizing and stimulus-controlled supramolecular systems, which has not been reported previously. Additional impact of the project will concern the application of the *bottom-up* strategy for supramolecular chemistry, which enables control over materials formation by hierarchical organization of nanostructured building blocks taking advantage of the understanding of structure/bonding/reactivity/properties correlations. In that context, the research of the project possesses a very high degree of novelty and should open new opportunities for hybrid organic-inorganic architectures. The results of the project hold potential applications in materials science, biosensing, drug-delivery systems, energy conversion, hybrid electronics and catalysis.