Smart materials we understand advanced materials, complying with the specific possibilities for applications, for example in the energy, electronics or medicine. These materials are used in cases, where are required specific optical, electrical, biological, physical or chemical properties. This group of materials now determines to a considerable degree about present development of the major branches of the economy in the world, and searching of the new advanced materials also had an influence on the teaching program of many universities, which where created the new thematic discipline – *Smart*/*Functional Materials*.

Smart materials for their specific properties can be divided into: physical (conductive polymers, superconductors, magnetostrictive materials), chemical (a new generation of catalysts as well as brightly Light Emitting Electrochemical Cell – LEC, reversible, selective sensors) and biological (biosensors, smart drug transporters etc.). However, regardless of the potential application, all materials must be synthesized in chemical laboratories and then made their basic investigations in order to determine the specific properties of these materials. Only later also physicists, engineers or biologists may participate in investigations to find the appropriate applications.

Our group for many years engaged in synthesis and investigations of specific physico-chemical properties of new coordination compounds, for example coordination clusters and polymers (CP's) as well as metal-organic framework (MOF), that could be used potentially as smart materials. We have experience in the control of the coordination modes of multidimensional organic linkers to the transition metal ions, and we were able to obtain promising class of *tailor-made* coordination polymers/supramolecular clusters and discrete complexes. Design and synthesis of coordination polymers is now intensively developing the field of crystal engineering (obtaining crystals of the preferred properties), supramolecular inorganic chemistry, and material science. Designed and prepared by us coordination compounds synthesized from metal- inorganic nodes of the 11 group of the periodic table, and organic linkers may become an alternative for current conventional porous materials such as zeolites, *etc*. Additionally, their properties can be tuned through suitable functionalization of the ligands, and change their steric and electronic properties, to have an influence on the architecture of the polymer structures. This advantage is particularly important for investigations of the advanced properties used compounds. One of the Cu-complexes we obtained and reported recently is copper(I) 2-D coordination/cluster polymer, which has been shown to be very sensitive and reversible aniline sensor, which might soon be used e.g. in medical diagnosis as *the naked eye sensor*.

In the light of our research results and our experience, we are interested in an extension of the research field towards design of novel homo- and heterometallic coordination compounds (coordination polymers, supramolecular clusters), constructed from various organic linkers, like 1,3,5-triaza-7-phosphaadamantane ligand (PTA) and its derivatives, as well as other auxiliary organic/inorganic ligands/counterions. As a metal center will be used Cu(I/II) and as additionally also Ag(I), Au(I,III), Ru(II/III) *etc.*, exhibiting special properties (*e.g.* luminescent, as a metal nodes for design and construction of coordination polymers). Obtained coordination compounds will be structurally characterized and most promising compounds will be selected and their specific advanced properties will be studied.

Important objective of the project is research the impact of different physical and chemical stimuli on the absorption and emission properties of the obtained compounds in the direction the ability to apply them, for example as selective and reversible sensors, TADF emitters and efficient LEC's.

It is expected, that the realization of the present project will result in:

- the extension of the still limited family of homo- and heterometallic coordination compounds and supramolecular clusters,
- the determination of structural, spectroscopic, luminescent and other properties of these compounds,
- the establishment of their advanced applications as luminescent materials (cheap and more brightly LEC devices, using Cu(I) coordination compounds instead *e.g.* Ir, Pt or Au metals), sensing, in anion or guest exchange, gas sorption etc., which might find further applications in electronics, medicine as diagnostics systems, in gas purification and separation or for selective gas isolation/storage, and in catalysis.

It should be noted the relatively simple, inexpensive and eco-friendly methods previously published by us, as well as proposed in this project – of synthesis of transition metal compounds (syntheses mainly in aqua media), especially the coordination polymers, which is an advantage in comparison to relatively complicated and expensive multi-stages syntheses of other compounds of these type, described in the literature. Thanks to these advantages, obtained according to the this project materials may easier find practical application in the future.