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Marcin Świątkowski
Supervisor: Rafał Kruszyński, PhD
Institute of General and Ecological Chemistry
Faculty of Chemistry
Lodz University of Technology

Synthesis and structure of group 12 coordination compounds, serving as precursors of nanoparticles with predetermined habit

Application of coordination compounds as precursors for production of nanoparticles is an interdisciplinary direction of research, connecting two fields of science i.e. coordination chemistry and nanotechnology. The synthesis of nanoparticles of binary metal compounds via thermal conversion of coordination precursors allows governing of size and morphology of nanoparticles. The development of effective methods of selective synthesis of nanoparticles is one of the most important tasks of modern nanotechnology, because the achievement of expected properties of nanoparticles requires precise control of their shape and size.

The aim of the PhD thesis was the design, synthesis and characterisation of new coordination compounds of group 12, which can serve as precursors in selective synthesis of nanoparticles of respective metal oxides produced via controlled thermal conversion of single precursor.

The O-donor ligands (short-chain carboxylate anions) and N-donor ligands (hexamethylenetetraamine, 2,2'-bipyridine and 1,10-phenanthroline) were used in the synthesis of group 12 coordination compounds. The coordination compounds were synthesized in water solutions, via direct reactions between group 12 carboxylates and N-donor ligands, and then they were isolated from mother liquors in the form of single crystals. The synthesized coordination compounds were characterized by X-ray crystallography, IR spectroscopy and thermal analysis. The intentional design of compounds allowed achievement of structurally diverse coordination compounds, which created model group of nanoparticles precursors and permitted the investigation of relationships between the crystal structure of precursors and the form of nanoparticles.

The coordination compounds (single precursors) were converted into nanoparticles of group 12 oxides in controlled thermal decomposition process. This process was designed on the basis of thermal analyses data. The optimization of conversion parameters (heating rate and maximum temperature) was performed for selected precursors. The synthesized nanoparticles were characterized by scanning electron microscopy. The thermal conversion of

coordination precursors allowed production of nanoparticles with various size and morphology. On the basis of above described investigations, the relationship matrix, connecting size and morphology of nanoparticles with crystal structure of precursors and with thermal conversion parameters, was constructed.

The PhD thesis outlines the potential of governing of the nanoparticles size and shape by correctly designed structure of coordination precursor. Additionally, the design and synthesis of new coordination compounds, together with association of their structural features with observed physicochemical properties, contribute to development of group 12 coordination chemistry. The research on application of coordination compounds as precursors of nanoparticles results in the progress of nanomaterials production methods and consequently in the advancement of nanotechnology.