

ABSTRACT

dissertation for the degree of Doctor of Philosophy (Ph.D.)

specialty 6D060600 - Chemistry

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Synthesis of metal nanocomposites and their application in catalysis

The thesis is devoted to the synthesis and stabilization of metal nanoparticles on the basis of polyamidoamine dendrimers, the study of their catalytic activity.

Background study. Mono- and bimetallic nanoparticles of the transition metals are of great interest in chemistry, biology, physics and materials science due to the fact that new promising possibilities for practical use of nanomaterials in many areas of science and technology. Metal nanoparticles are used for efficient and selective catalysts, the creation of microelectronic components, sensors, and optical devices, the synthesis of new materials with specific properties.

A large amount of research devoted to the development of new catalysts, offered highly effective catalysts Suzuki-Miyaura reaction and Mizoroki-Heck with trifenylphosphine ligands. However, these ligands are toxic and difficult to access because of the complexity of synthesis. Therefore, the development of modifications of carbon-carbon reaction with the use of effective, selective, simple and affordable catalysts is an important and urgent scientific task.

Objects of study. Nickel nanoparticles in polyethylene glycol, nanoparticles of palladium and bimetallic palladium nickel-based polyamidoamine dendrimers.

Subject of study. The processes of formation of nanocomposites, physical and chemical properties of nickel nanoparticles stabilized in polyethylene glycol, dendrimer-encapsulated palladium nanoparticles and bimetallic systems Ni-Pd; composition, dimensional characteristics and catalytic properties of palladium nanoparticles.

The aim of this work is the development of new methods for the synthesis of nanoparticles of nickel, palladium, nickel, palladium, stabilized in the dendrimers and polymers, the study obtained nanocatalysts in Suzuki-Miyaura and Mizoroki-Heck reactions.

According with the purpose of the study there is following main **objectives**:

- to develop methods for synthesis of palladium nanoparticles in a low generation dendrimer based on polyamidoamine and nickel in the organic polymer of polyethylene glycol;
- to establish the basic nature of the influence of the dendrimer and polymer to form nanoparticles of palladium and nickel;
- to study the basic physical and chemical properties of the metal nanocomposites;
- to study the physical and chemical properties of the dendrimer-encapsulated bimetallic nanoparticles NiPd;
- to study aspects of the practical application of the synthesized dendrimer-palladium nanocomposites in catalysis.

Methods: NMR, UV, IR spectroscopy, transmission electron microscopy, X-ray photoelectron spectroscopy and X-ray powder diffraction.

Source materials and research materials are 190 sources of literature on inorganic and organic chemistry, polymer chemistry, and other fields of science relevant to the subject of this study.

Scientific novelty of the thesis is as follows:

- Worked out methods of synthesis of metal-based nanocomplexes on the basis of terminally functionalized dendrimers;
- Determined the main parameters of the synthesis, affecting the size and composition of the nanoparticles;
- Studied the effects of dendrimer branches and relations stabilizer: average diameter of palladium nanoparticles;
- First studied the catalytic properties of palladium nanoparticles stabilized in a modified polyamidoamine dendrimer based on the first generation in the formation of carbon-carbon bonds.

Theoretical value. Theoretically, the results concerning the method of synthesis of metal nanocomposite materials, the study of their physical and chemical properties, have an interest for the future development of various modifications of nanocomposites and their studies in order to obtain materials with desired properties.

The practical significance. The developed method of synthesis of metal nanoparticles in a low generation dendrimers produces nanocomposites easily, which can be used as catalysts cross-coupling Suzuki-Miyaura and Mizoroki-Heck.

The main results of the thesis is presented in 11 published works, including 5 articles in publications from the list approved by the Committee for Control of Education and Science of RK, one article in a journal ranked high citation index, also 4 articles and 1 thesis in materials of international and national conferences.

Structure and length of the dissertation. The thesis presented in 115 pages, including an introduction, four chapters, conclusion, 51 figures, 12 tables and a list of references of the 190 items.