

Cobalt and Iron Complexes With Aminophosphine Ligands: Catalysts Design for Organic and Organometallic Synthesis

With the continuously growing interest in products precisely tailored to specific needs, the demand for designing appropriate technologies for this purpose has increased. However, in an era of heightened awareness and social responsibility, further development in various industrial sectors should not only be guided by economic considerations but also be in line with environmentally friendly solutions. Therefore, the task of scientists has become the development of innovative and sustainable strategies leading to obtaining materials with high application potential.

However, due to the high cost and toxicity of noble metal catalysts commonly used in significant chemical transformations, there is a trend away from their use. At the same time, methods based on cheaper, readily available, and widely occurring transition metal compounds, which could exhibit similar or improved catalytic properties, have gained great importance. In addition to addressing economic and environmental aspects, certain complexes of 3d-transition metals, including cobalt and iron, have demonstrated high selectivity and efficiency in the synthesis of organic and organometallic compounds.

For a long time, the aim of organometallic chemistry and homogeneous catalysis has been the rational design of metal complexes in such a way as to easily control their steric and electronic properties. The ideal tool for this purpose turned out to be complexes containing pincer ligands, whose increased stability, simplicity of modification and ease of use have recently gained great popularity. Their high catalytic activity and selectivity have led to their application as catalysts in various fields, from energy to asymmetric catalysis.

The scientific goal of this project is to obtain a series of new cobalt and iron complexes with aminophosphine ligands, particularly of the pincer type, and then to examine their catalytic activity in organic and organometallic synthesis. The most important aspect of these studies is to compare the influence of ligand structure on the activity and selectivity of the obtained catalyst. As a result, original, efficient, and highly selective strategies for hydroelementation, dehydrogenative coupling, and hydrogenation under mild conditions will be developed. The use of inexpensive and readily available catalysts will enable access to a wide range of organic, organosilicon, and organogermanium products in a sustainable manner. These compounds play a significant role in various aspects of our lives, including medicine, pharmaceuticals, cosmetics, textiles, and construction. Additionally, they serve as key intermediates in the synthesis of natural products and fine chemicals, as well as valuable products in materials chemistry. An important element will also be learning about the mechanisms of the investigated catalytic processes, which will contribute to deepening the existing knowledge in this field.