

Synthesis of ruthenium complexes with CAAC ligands, application in metathesis reactions

Catalysis is one of the fundamental forces pushing the development of our civilization. Many chemical processes would not be possible without the use of individuals called catalysts, which make it possible to produce, inter alia, drugs, polymers or fragrance compounds in a simple and efficient method. Another example is the synthesis of ammonia, sulfuric acid or the cracking of crude oil. An important role in this area is played by processes using organometallic complexes, e.g. ruthenium, among others, in the olefin metathesis – a high-potential reaction – enabling the synthesis of new carbon-carbon bonds. Despite many applications and a large portfolio of catalysts, there are still a number of problems to be solved, including poor resistance to: oxygen, water, ethylene, as well as low stability and activity in metathesis reactions enabling the transformation of compounds derived from biomass.

Within the framework of the SONATA project, we want to focus on the development and application of new olefin metathesis catalysts with cyclic (alkyl)(amino)carbenes (CAAC). The goal of our research will be to develop and synthesize new ligands to understand how structural and electronic modifications impact the stability and activity of olefin metathesis catalysts. The results of this research will be used to develop new systems with improved properties.

Undertaking research leading to the synthesis of new olefin metathesis complexes is due to the need to increase the efficiency of chemical reactions (higher yields, better selectivity) and their suitability to the reaction conditions (high temperature, ethylene pressure). In many metathesis reactions, the main problem requiring improvement is the low catalyst lifetime, resulting in significantly reduced process efficiency. It is therefore crucial to understand the mechanisms that lead to this, and to develop new solutions. This will represent an important step in the development of chemistry. In our work, we aim to obtain catalysts that will not only enable specialised use in ethenolysis reactions but also open up a wide range of applications in other types of olefin metathesis.

The project has the potential to innovate in the field of catalysis, moreover, it can contribute to a more complete understanding of olefin metathesis through the proposed modifications. Enabling more efficient use of raw materials and reducing waste are key goals for many economies around the world, and this could be an added value in the project as a complement to the goals we wish to develop and ultimately achieve. We believe our findings will benefit both the academic and industrial contexts, opening the door to new opportunities in chemistry.

