D. Shemagonov, V. Radziyeuskaya
Belarusian State University, Minsk

ORGANOCATALYSIS AS A PROMISING FIELD OF CHEMISTRY

Nowadays, enzymes are widely used in enantioselective reactions. They have 100% of enantioselectivity, and due to that, they are commonly applied in the pharmaceutical industry. However, only one stereoisomer of each enzyme is available, which imposes some hard limits on their application.

The purpose of the research is to make a comparative study of organic catalysts based on the latest discoveries in organic chemistry.

Lately, great achievements have been made in the field of metal-based catalysis. Each year more and more enantioselective metal-based catalysts are being discovered. Organometallic catalysts contain atoms of a transition metal and chiral ligands, and this enables asymmetric syntheses to be conducted with enantioselectivity of up to 100 percent. In addition to their indisputable advantages, some disadvantages discourage their widespread use. Metal-based complexes are difficult to synthesize due to their instability. This fact greatly increases the cost of such catalysts. But even bigger challenges are caused by the difficulty of separation of such compounds from the final products. That is particularly relevant for the pharmaceutical industry, as even trace amounts of heavy metals are inadmissible in the composition of medicines due to their toxicity.

In recent years, the interest in the new asymmetric catalysts has highly increased as a result of the development of organocatalysis. It is a completely new form of catalysis, which is based on the use of small organic molecules as catalysts. Over the past century, some organic molecules which can act as asymmetric catalysts were reported, with proline being described first [1]. Nowadays, organocatalysis is developing more and more rapidly. Its relevance

was demonstrated by the Nobel prize in Chemistry awarded to Benjamin List and David McMillan in 2021 [2].

Organic catalysts have several advantages which make them stand out from the other ones. Organic molecules are stable, and they are unaffected by oxygen, moisture, etc. Moreover, organic compounds are much cheaper, and it is much easier to carry out the synthesis with them. But more importantly, most organic substances used in the chiral synthesis are non-toxic and environmentally friendly. Such catalysts appeared to be of great use in drug and natural product synthesis [3].

Enantioselective catalysis plays a key role in most reactions in modern chemistry. It is particularly important in pharmaceutical chemistry as the different stereoisomers of a compound may have a completely different biological activity: one form may positively affect an organism, whereas another form may have no effect or even be dangerous and unsuitable for use. It is hard to predict the future of the development of asymmetric catalysis but based on our research, the most promising branch in this field is organocatalysis because of a large number of advantages compared to other forms of catalysis.

References

1. Asymmetric synthesis of optically active polycyclic organic compounds : pat. DE 2102623 / Z. G. Hajos, D. R. Parrish. — Publ. date 29.07.1971.

2. Press release: The Nobel Prize in Chemistry 2021 [Electronic resource]. — Mode of access: https://www.nobelprize.org/prizes/chemistry/2021/press-release/. — Date of access: 22.12.2021.

3. Figueiredo, R. M. Organocatalytic Synthesis of Drugs and Bioactive Natural Products / R. M. Figueiredo, M. Christmann // Eur. J. Org. Chem. — 2007. — iss. 16. — P. 2575 — 2600.