Tytuł projektu

Synteza i zastosowanie nowej klasy chiralnych katalizatorów azotowo-chalkogenidowych

Project title

Synthesis and Application of a New Class of Chiral Nitrogen-Chalcogen Catalysts

Dyscyplina /Area of science

Nauki chemiczne

PROJECT DESCRIPTION

Project goals

- Preparation of an efficient methodology for the synthesis of new chiral catalysts
- The synthesis of aziridine-based organosulfur and organoselenium ligands, not described in literature
- Characterization of the structure of the ligands by spectroscopic methods
- Application of the new compounds as catalyst in selected asymmetric reactions
- Selection of the structural elements that are crucial for obtaining high enantio- and diastereomeric excess

Outline

The synthesis of enantiomerically and diastereomerically pure reagents and catalysts is currently one of the main research topics in modern organic synthesis. The reason of this broad interest is connected with different reactivity in asymmetric reactions, biological activity, therapeutic effect and toxicity of specific enantiomers/diastereomers. The goal of this project is the synthesis of chiral nitrogen-sulfur and nitrogen-selenium ligands, not known in the literature, which through complexing of metals in selected catalytic reactions, would enable to obtain enantiomerically pure products from prochiral substrates. The novelty of the project is closely related to the structure of the compounds planned to be obtained. The designed derivatives will have two key structural elements: optically active aziridine ring and chiral or achiral organosulfur or organoselenium moiety. Till now, chiral aziridines, functionalized on the nitrogen atom and one or two carbon atoms, and also various S- and Se-derivatives, were successfully applied as catalysts/ligands in asymmetric synthesis. The development of an efficient method for the synthesis of compounds that would combine these two building blocks would enable to obtain a new class of chiral catalysts and evaluate the influence of the chalcogenide substituent on the yield and enantiomeric excess in selected asymmetric reactions.

Work plan

1. The use of commercially available aminoacids in the synthesis of chiral aziridine substrates.
2. Transformation of the obtained aziridines into the corresponding sulfides and selenides using two different types of chalcogenide precursors: disulfides or diselenides, and thiols or selenols previously synthetized in our research group.
3. Structural modifications of the obtained derivatives that will include the change of the moiety on the aziridine nitrogen atom and the application of various chalcogenides – aromatic derivatives with electron withdrawing and electron donating groups and also chiral aliphatic structures.
4. Purification and characterization of the obtained compounds with the application of chromatographic and spectral methods.
5. Testing of the catalytic efficiency of synthesized ligands in selected asymmetric reactions.

Literature

J. Ścianowski, et. all.; Eur. J. Org. Chem. (2006), 3216-3225.
J. Ścianowski, et. all.; Tetrahedron, 65, (2009), 10162-10174.
J. Ścianowski, Z. Rafiński, Organoselenium Chemistry: Between Synthesis and Biochemistry; Santi,C., Ed.; Bentham, (2014), 8-60.
J. Ścianowski, A. J. Pacuła, at. all.; New J. Chem. 40, (2016), 6697-6705.
L. Sancineto, F. Mangiavacchi, at. all.; Asian J. Org. Chem. 6, (2017) 988–992.
M. Obieziurska, A. Pacuła, at. all.; Catalysts 8 (2018) 1–14.

Required initial knowledge and skills of the PhD candidate

- ➔ Practical skills enabling to work in an organic chemistry laboratory
- ➔ Ability to plan and perform syntheses of organic molecules
- ➔ Experience in the field of organochalcogen chemistry
- ➔ Understanding of molecular biology and physics
- ➔ Knowledge about basic methods to characterize compounds (IR, NMR, GC-MS, HPLC)

Zgłaszający projekt/ Author of the project

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Proponowani promotorzy i mentorzy/prospective supervisors

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2) promotor pomocniczy / co-supervisor	
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