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DOCTORAL THESIS
Summary

Flow methods in the synthesis of chiral and achiral heteroorganic compounds

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This study was aimed to examine the possibility of using flow methods in selected chemical reactions. Efforts were focused on carrying out reactions of heteroorganic compounds, paying particular attention to sulfur, phosphorus and selenium compounds. As model examples, the preparation of phosphinyl chlorides in the chlorination reaction of secondary phosphine oxide, the synthesis of phosphonates in the Michaelis-Arbuzov rearrangement, the alcoholysis of *H*-phosphonates or the synthesis of significant from the biological point of view 2,2'-diselenobis(benzoic acid) (DSBA) and its analogues have been exploited.

In case of the phosphonate synthesis via the Arbuzov rearrangement, the processes were conducted mainly under solvent-free conditions, without using a catalyst in a fully-automated Syrris microreactor. A variety of alkylphosphonic esters were obtained using short reaction times (8.33-50 min) and with excellent conversions (up to ≥99%).

The flow methods utilizing microreactor devices have shown to be applicable in the synthesis of phosphinyl chlorides, starting from the corresponding secondary phosphine oxide and carbon tetrachloride. This work demonstrated the limitations of this method and emphasizes the importance of steric hindrance. In this case, the *tert*-butyl group was found to allow the chlorination reaction of selected phosphine oxides.

Moreover, described experiments were conducted to test, whether the flow conditions could be applied to perform reactions of selected *H*-phosphonates with a number of aliphatic alcohols, as well as examples of esterification reactions of *para*-toluenesulfinyl chloride with selected achiral alcohols or optically active menthol too. The results obtained, show the limitations of the method used in the case of diastereomeric derivatives.

In addition, the flow synthesis of DSBA and its derivatives was carried out using water as solvent and reaction times of only seconds. This is the first flow example of the synthesis of diselenides described in the literature. The obtained positive results, as well as the conclusions drawn from presented experiments, indicate the possibilities of using flow methods for a variety of other reactions, than those presented.