



Slovak Society of Chemical Engineering  
Institute of Chemical and Environmental Engineering  
Slovak University of Technology in Bratislava

## PROCEEDINGS

51<sup>st</sup> International Conference of the Slovak Society of Chemical Engineering SSCHE 2025

Hotel DRUŽBA  
Jasná, Demänovská Dolina, Slovakia  
May 27 - 30, 2025

Editors: Assoc. Prof. Mário Mihaľ

ISBN: 978-80-8208-158-2, EAN: 9788082081582

Published by the Faculty of Chemical and Food Technology Slovak Technical University in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2024

Lambarska, A., Hanefeld, U., Szymańska, K.: Flow Chemistry for the Enantioselective Synthesis of Chiral Cyanohydrins, Editors: Mihaľ, M., In *51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025*, Jasná, Demänovská Dolina, Slovakia, 2025.

## Flow Chemistry for the Enantioselective Synthesis of Chiral Cyanohydrins

Aleksandra Lambarska<sup>1,2</sup>, Ulf Hanefeld<sup>2</sup>, Katarzyna Szymańska<sup>1</sup>

<sup>1</sup>*Department of Chemical Engineering and Process Design, Faculty of Chemistry,  
Silesian University of Technology, 44-100 Gliwice, Poland*

<sup>2</sup>*Biocatalysis, Department of Biotechnology, Delft University of Technology, 2629 HZ Delft,  
the Netherlands*

*e-mail: aleksandra.lambarska@polsl.pl*

**Key words:** chiral cyanohydrins, flow chemistry, Henry reaction, heterogeneous biocatalysts, hydroxynitrile lyases, silica carriers

The demand for chiral cyanohydrins has been steadily increasing due to their broad applications in various industries, such as horticulture, cosmetics, pharmaceuticals, and, notably, the chemical industry. These compounds serve as valuable intermediates in the synthesis of *fine chemicals*, including  $\alpha$ -hydroxy acids, aldehydes, ketones, and amines. Despite their importance, the chemical synthesis of chiral cyanohydrins often involves complex procedures, prompting the exploration of biocatalytic routes as a more sustainable alternative.

Flow chemistry has emerged as a powerful approach in chemical synthesis, providing precise control over reaction conditions and enhancing scalability compared to traditional batch processes. This continuous mode facilitates efficient heat and mass transfer, making it promising for reactions involving complex biocatalysts. The combination of flow chemistry with biocatalysis not only improves reaction efficiency but also reduces waste and energy consumption, aligning with *green chemistry* principles. In this context, the Henry reaction, involving the addition of a nitroalkane to a carbonyl compound, is particularly relevant for synthesising chiral cyanohydrins, producing valuable intermediates like  $\beta$ -nitroalcohols.

In this study, we investigated the covalent immobilisation of hydroxynitrile lyase from *Granulicella tundricola* (GtHNL-3V) on organically modified monolithic microreactors (MHs) with amino (A) and octyl (O) groups. The activity, stability, and enantioselectivity of the heterogeneous biocatalysts were evaluated in the continuous synthesis of chiral cyanohydrins: *R*-mandelonitrile in an organic medium with buffer saturation and *R*-1-phenyl-2-nitroethanol in a biphasic system.

**Acknowledgement:** The corresponding author gratefully acknowledges the general financial support from the Ministry of Science and Higher Education (Poland) program under grant PERŁY NAUKI agreement PN/01/0267/2022.