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

PROCEEDINGS

52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026

Hotel SOREA TRIGAN
Štrbské Pleso, Slovakia
May 26 - 29, 2026

Editors: Assoc. prof. Mário Mihaľ

ISBN: 978-80-8208-177-3, EAN: 9788082081773

Published by the Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2026

Sauer, L., Sklenář, A., Vobecká, L., Slouka, Z., Kralik, D., Přibyl, M.: Alignment of characteristic times in microfluidic systems for the preparation of enantiomers, Editors: Mihaľ, M., In *52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026*, Štrbské Pleso, Slovakia, 2026.

Alignment of characteristic times in microfluidic systems for the preparation of enantiomers

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Our contribution addresses the design of microfluidic systems with harmonized characteristic times for the continuous synthesis and separation of chiral chemicals. The concept is based on matching the residence times of individual modules in modular microfluidic arrangements to achieve time-balanced reaction and separation processes. Two case studies are presented: the enzymatic production of mandelic acid enantiomers and the synthesis of (*R*)-1-phenylethanol. In both systems, immobilized lipases are used in packed-bed microreactors to perform enantioselective biocatalytic transformations. The reaction products are subsequently separated using orthogonal techniques such as electrically driven membrane separation or microfluidic liquid–liquid extraction. Harmonization of characteristic transport times, including convection and electromigration, enables efficient coupling of synthesis and separation in continuous flow. The results demonstrate that proper matching of characteristic times allows individual modules to operate with comparable volumes and performance.

Keywords: enantiomer; mandelic acid; (*R*)-1-phenylethanol; orthogonal separation; continuous flow separation

Acknowledgement: The authors thank for the support by the grant of the Czech Science Foundation (grant no. 24-11480S).

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