Process intensification of the synthesis of glycerol carbonate under microwave irradiation or continuous-flow conditions

AUTHORS
Julien ESTAGER / CERTECH ASBL, RUE JULES BORDET ZONE INDUSTRIELLE C, SENEFFE
Jessica PLECK / CERTECH ASBL, RUE JULES BORDET ZONE INDUSTRIELLE C, SENEFFE
Jean-Christophe MONBALIU / CENTER FOR INTEGRATED TECHNOLOGY AND ORGANIC SYNTHESIS - CITOS - UNIVERSITY OF LIEGE, BUILDING B6A, ROOM 3/16A ALLEE DU SIX AOUT 13, LIEGE (SART TILMAN)
Romaric GERARDY / CENTER FOR INTEGRATED TECHNOLOGY AND ORGANIC SYNTHESIS - CITOS - UNIVERSITY OF LIEGE, BUILDING B6A, ROOM 3/16A ALLEE DU SIX AOUT 13, LIEGE (SART TILMAN)

PURPOSE OF THE ABSTRACT
Despite low crude oil prices and the increasing access to shale gas, the establishment of a biobased economy remains a worldwide priority. An integrated biobased economy would not only consider renewable biobased resources to provide industrially relevant chemicals, but would also redefine chemical processing by using greener, safer and more selective process technologies. The last few decades have witnessed the emergence of promising alternative energy sources such as microwave irradiation and alternative process technology such as continuous-flow reactors.

Even if biobased chemicals are still marginal on the market compared to petrochemicals, many biorefineries are now able to convert biomass into biobased chemical building blocks of good purity on large scales. Amongst these products, glycerol—a side product of the biodiesel industry—is a particularly appealing chemical platform thanks to its high functionality and its wide availability. Various high-value added chemicals can be obtained from glycerol, among which glycerol carbonate retained our attention. Glycerol carbonate is an attractive glycerol derivative that can be used in many applications ranging from low-VOC solvent to polymer synthesis. Many publications describe its synthesis using different catalysts or alternative activation methods such as microwave.

Our research effort in process intensification for the industrial valorization of biomass led us to develop an intensified carbonation process of glycerol under microwave irradiation, affording an unprecedented reactivity with short reaction times and high selectivity towards glycerol carbonate. Based on this preliminary study, and using the microwave-to-flow paradigm, continuous-flow processes using mesofluidic reactors have been developed to obtain glycerol carbonate in good yield and high purity.
FIGURES

FIGURE 1
Process intensification of the green synthesis of glycerol carbonate
Graphical abstract

FIGURE 2

KEYWORDS
biobased chemicals | microwave | flow chemistry | glycerol

BIBLIOGRAPHY