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Modular continuous processes for the point-of-use / on-demand generation and utilization of highly reactive diazo reagents

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PURPOSE OF THE ABSTRACT

An effective way to achieve greener and more sustainable chemical processes in the production of fine chemicals is the utilization of highly reactive intermediates which allow more direct synthesis routes with reduced numbers of reaction steps. The result is a significant reduction in waste, energy and solvent consumption. This is particularly important in the production of specialty chemicals, where the E-factors are orders of magnitude higher than for bulk chemicals. A mandatory prerequisite for the use of highly reactive and therefore often hazardous reagents in green chemistry is to ensure high, ideally inherent, process safety, especially in view of a possible upscaling of such processes.

Continuous manufacturing and flow chemistry unlock new reactive paths exploiting harsh reaction conditions and utilizing unconventional reactive reagents. Here we present our ongoing work on the development of modular continuous processes for the point-of-use and on-demand generation of highly reactive diazo intermediates for follow up processes.

This work is part of the Fraunhofer lighthouse project "ShaPID", in which nine Fraunhofer institutes are pooling their applied research in the fields of green chemistry, process intensification and digitalization to provide targeted support to the chemical industry in de-fossilizing its production processes and establishing sustainable material and energy conversion.

Diazo compounds are reactive and remarkably versatile building blocks and thus allow synthesis routes with high atom efficiency. Challenging is the toxicity and the often explosive nature of the diazo compounds, which can be effectively handled by using microstructured flow reactors for in situ synthesis. We show the development and the optimization of the generation of different diazo building blocks (e.g. diazo esters, diazonitriles, diazoalkanes) by different routes (e.g. diazotization of amines, basic elimination of nitroso compounds, (electro-)oxidation of hydrazones) to be used for direct conversion in a second reaction step.

Furthermore, we give an overview about our smart, efficient and scalable plant concept, which is being developed with various partners from the fields of process engineering, simulation and automation.

FIGURES

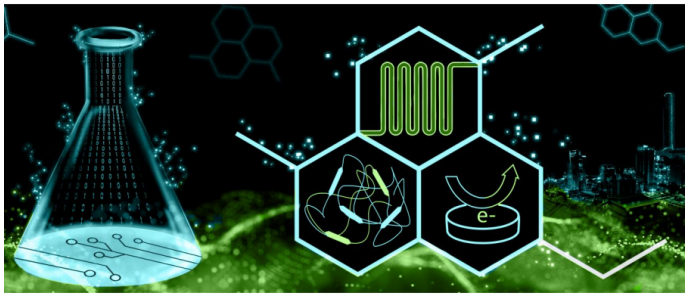

FIGURE 1
"ShaPID"
Fraunhofer Lighthouse Project

FIGURE 2

KEYWORDS
flow chemistry | modular processes | reactive building blocks | process digitalization

BIBLIOGRAPHY