Integrated continuous flow photoreactors: Photooxidation of (L)-methionine with singlet oxygen

Noémie Emmanuel [1], C. Mendoza [2], M. Winter[4], C. R. Horn[4], A. Vizza[4], L. Dreesen [3], B. Heinrichs [2], J-C. M. Monbaliu* [1]

[1]Center for Integrated Technology and Organic Synthesis, Department of Chemistry/ [2]Nanomaterials, Catalysis, Electrochemistry, Department of Chemical Engineering / [3]Biophotonics, Department of Physics, University of Liège, B-4000 Liège (Sart-Tilman), Belgium / [4]Corning Reactor Technologies, Corning SAS, 7 bis Avenue de Valvins, CS 70156 Samois sur Seine, 77215 Avon Cedex, France (N.Emmanuel@uliege.be)

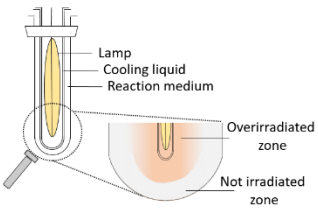
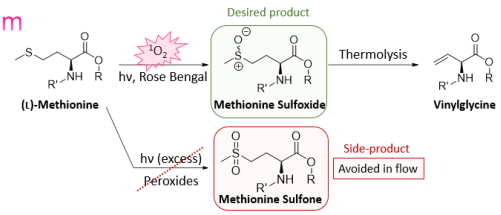


Figure 1 :
Usual immersion well with a lack of homogeneous irradiation

1 | INTRODUCTION

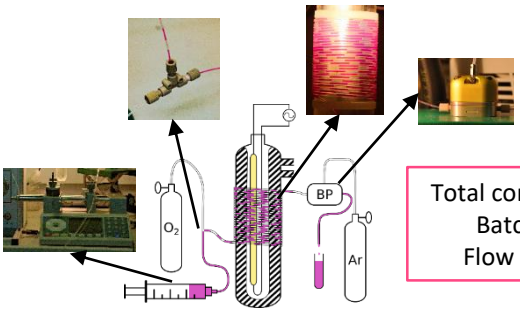
Development of photochemistry in macroscopic **batch** reaction vessels is hampered due to inherent limitations: **superficial light penetration** and **poor heat exchange** result in inhomogeneous irradiation and hence to side-reactions or product degradation due to **overexposure**. The recent implementation of photochemical processes in **microreactors** under continuous-flow conditions appeared to be **much more powerful** than its batch analogue in terms of **irradiation efficiency**, light penetration and excellent heat exchange. Furthermore, the fine **control of residence time** ensures an accurate control of the irradiation time, avoiding side-reactions and degradation.

2 | Aim



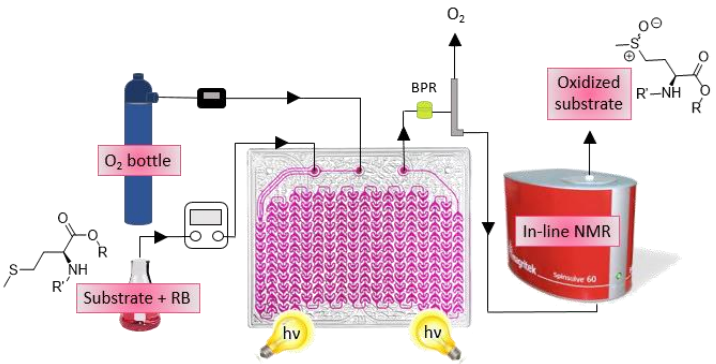
The aim was to **implement the photooxidation of (L)-methionine with singlet oxygen in microreactor** under continuous-flow conditions to avoid the formation of undesired side-product and improve the efficiency of the reaction.

3 | Home-made microreactor



Total conversion :
Batch 2 h
Flow ~1 min

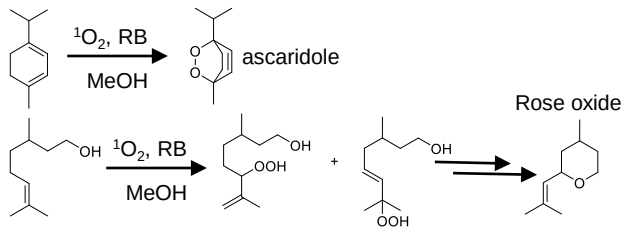
4 | Corning® Advanced-Flow™ Lab Photo Reactor



- ✓ **Control** of exposure time (residence time)
- ✓ Efficient and easy **scale-up**
- ✓ Segmented flow : excellent gas and liquid **mixing**
- ✓ **In-line** analysis

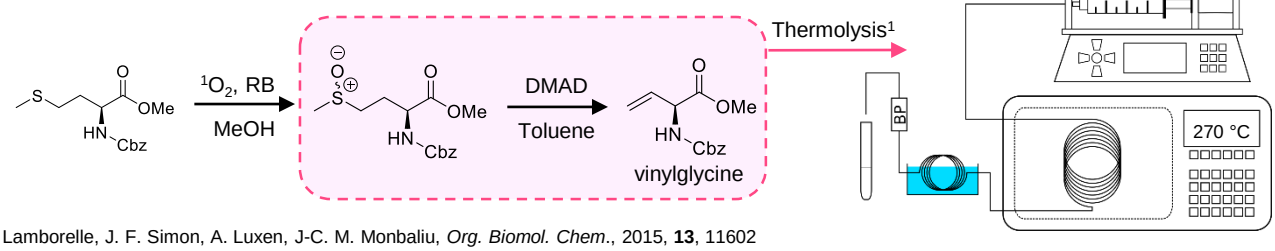
Total conversion in ~1 min (132 g.day^{-1})

Other substrates:



[1] N. Emmanuel et al., *Org. Process Res. Dev.*, **2017**, *21* (9), pp 1435–1438

5 | Thermolysis



[1] N. Lamborelle, J. F. Simon, A. Luxen, J-C. M. Monbaliu, *Org. Biomol. Chem.*, 2015, **13**, 11602

6 | Conclusion

The scalable photooxidation of (L)-methionine with singlet oxygen was successfully implemented in a microreactor setup and led to total and selective conversion into methionine sulfoxide, an important building block for the organic synthesis of peptides or functionalized amino acid. The reaction was performed **in ~1 min**. Cbz-methionine methyl ester was also photooxidized and successfully themolyzed into vinylglycine.

7 | Acknowledgements

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