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 | Photooxidation in batch immersion well

Methionine + Rose Bengal in water with O2 or Air bubbling

✓ [Rose Bengal] ✓ lamp intensity ✓ O2 rather than air Total conversion in 2 h

4 | 1H NMR

Singlet appearance (2.65) Triplet disappearance (2.55)

5 | Microreactor

O2 −→ Halogen Lamp

(H)Met → Methionine sulfoxide

7-8 bar

PFA tubing : easily exchangeable

Halogen lamp surrounded by cooling liquid

✓ Segmented flow ✓ O2 excess

Total conversion in <1 min

6 | Results

<table>
<thead>
<tr>
<th>Flow rates (mL min−1)</th>
<th>Back Pressure Regulator (Bar)</th>
<th>Temperature (°C)</th>
<th>Residence Time (min)</th>
<th>Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrat solution</td>
<td>O2</td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>0.5</td>
<td>15</td>
<td>7</td>
<td>30</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

Total conversion of (L)-methionine into methionine sulfoxide could be reached in only 1 min.

(Shorter residence times or lower O2 flow rates were not sufficient and could not lead to total conversion)

7 | Conclusion

The photooxidation of (L)-methionine with singlet oxygen using Rose Bengal as a sensitizer 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 while the same reaction in batch took 2h.

8 | Acknowledgements

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