PhotOnline'2023
Web-conference organized by and for young researchers – 2nd edition

Design, characterization and evaluation of a lab-made photoreactor: a first step towards standardized procedures in photocatalysis.

Thomas Aubineau*[1], Justine Laurent[2], Ludovic Olanier[3], Amandine Guérinot[1]

[1] *Molecular, Macromolecular Chemistry and Materials, ESPCI Paris - PSL, CNRS UMR7167, 10 rue Vauquelin, 75005 Paris, France*

[2] *Gulliver, ESPCI Paris - PSL, CNRS UMR7083, 10 rue Vauquelin, 75005 Paris, France*

3 Sciences et Ingénierie de la Matière Molle, ESPCI Paris – PSL, CNRS UMR7615, 10 rue Vauquelin, 75005 Paris, France

**thomas.aubineau@espci.fr*

Keywords: photochemistry • actinometry • lab-made reactor • reproducibility • 3D-printing

For the last ten years, photochemistry has known a renewal with the emergence of new photoredox approaches along with new powerful artificial sources of light. Significant pioneering works by MacMillan, Yoon and others paved the way for the description of numerous chemical transformations[1]. However, the drawback of the fast growth of this field is the lack of homogeneous reporting: the wavelength used, the light power received are, for example, not always described in the procedures, nor determined. This lacunar information hampers the development of standardized procedures which would guarantee the reproducibility of the reactions.

With the objective of furnishing a standardized and easy-to-use setup, a reactor was designed and 3D-printed in our lab. The light power received at different positions was measured by means of a chemical actinometer[2]. Power homogeneity over a same iso-line was assessed along with the possibility to run up to 6 reactions simultaneously with one lamp. Variation of the environment, *ie.* reflective coating, water bath, revealed the dramatic influence of seemingly insignificant parameters over the actual power received and thus upon the upcoming of the reactions.

This new reactor, fully characterized in terms of optical intensity, offers an easy and affordable approach to photochemistry[3]. The homogeneity of the light power induces increased reproducibility, and the possibility to tune the intensity received depending on the environment make the study of the power/yield relation easier.

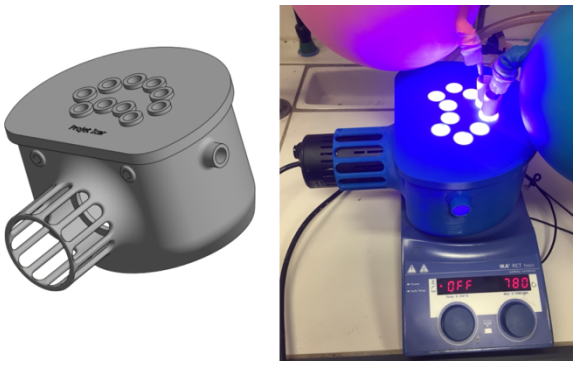

Figure 1. 3D view of the conceived reactor (left). Reactor in use (right).

[1] Selected reviews : a) M. Oelgemöller *Chem. Rev.* **2016**, *116*, 9664-9682. b) N. A. Romero, D. A. Nicewicz *Chem. Rev.* **2016**, *116*, 10075-10166. c) K. L. Skubi, T. R. Blum, T. P. Yoon *Chem Rev.* **2016**, *116*, 10035-10074. d) L. Candish, K. D. Collins, G. C. Cook; J. J. Douglas, A. Gómez-Suarez, A. Jolit, S. Keess *Chem Rev.* **2022**, *122*, 2907-2980. e) A. Y. Chan, I. B. Perry, N. B. Bissonette, B. F. Buksh, G. A. Edwards, L. I. Fryes, O. L. Garry, M. N. Lavagnino, B. X. Li, Y. Liang, E. Mao, A. Millet, J. V. Oakley; N. L. Reed, H. A. Sakai, C. P. Seath, D. W. C. MacMillan *Chem. Rev.* **2022**, 122, 1485-1542.

[2] a) C. A. Parker *Proc. R. Soc. Lond. A* **1953**, *220*, 104-116. b) C. G. Hatchard, C. A. Parker, *Proc. R. Soc. Lond. A* **1956**, *235*, 518-536. c) H. J. Kuhn, S. E. Braslavsky, R. Schmidt *Pure Appl. Chem*. **2004**, *76*, 2105–2146. d) M. Montalti, A. Credi, L. Prodi, M. T. Gandolfi Chemical Actinometry *in Handbook of Photochemistry,* 3rd edition, CRC Press : Boca Raton, **2006**. e) J. Rabani, H. Mamane, D. Pousty, J.R. Bolton *Photochem. Photobiol* **2021**, *97*, 873-902.

[3] Publication in preparation. *.step (conception) and *.stl (printing) files available open source on request.