

# DEVELOPMENT OF A UNIQUE AND FIRST-OF-ITS-KIND FLOW PHOTO REACTOR – CSCPR



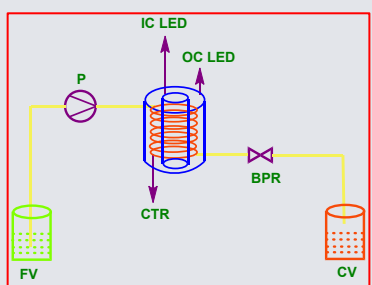
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## Introduction

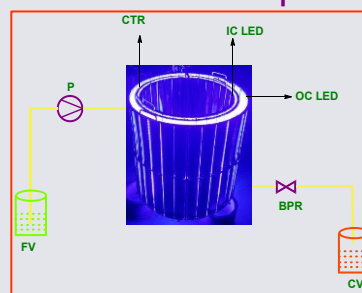
Though photo bromination offers an excellent low-cost and greener solution for various bromination processes, traditional batch photo bromination using Mercury and Xenon lamps suffers from several inherent issues, such as formation of undesired by-products, consuming high energy, and loss of efficiency due to a decrease in intensity as light travels through the reactor (Beer–Lambert Law). The majority of these shortcomings were addressed using flow photo reactors designed by several scientists across academia and industry. Corning G1 photoreactor is good example where a glass-plate channel continuous-flow reactor was used, overcoming most of the shortcomings found in batch photo bromination. We developed a unique and first-of-its-kind flow photo reactor using circularly sandwiched LEDs. This design not only takes care of all shortcomings described above in batch photo reactors, it also uses low-energy LEDs (450 nm) and offers uniform light intensity. Moreover, the annular shape of the reactors ensures that all emitted light is utilized, as light emitted at different angles also strikes the reactor surface without escaping, thanks to the circular geometry in CSCPR!

## Results: Design to Development of the Unique Photo Flow Reactor (CSCPR)

### Initial Idea



### Proof-of-concept



### Final Reactor (CSCPR)



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in Developing  
Customized Flow  
Solutions to our  
Customer Needs*

## Discussion

### Main Features:

- Unique Circularly Sandwiched Continuous Photo Reactor, a first-of-its-kind.
- Modular design with HMI (automation).
- Robust reactor design with high-intensity long-lasting LED lights embedded with heat sinks.
- Wattage can be adjusted from 200W to 1200W with the wattage modulated switch.

## Discussion (cont.)

### Reactor Technical Achievements

- ✓ Significantly increased reaction speed  
=> 2 min residence time on 2L reactor
- ✓ High efficiency with high quantum yields > 300  
=> So, more energy efficient!
- ✓ High throughput, ~ 40 Kg/day.  
=> Can produce bromination product ~2 tons/month
- ✓ Amenable to scale up.  
=> A simple 5x scaled-up reactor can product ~10 tons/month

## References

1) J. P. Knowles, L. D. Elliott, K. I. Booker-Milburn, Beilstein J. Org. Chem. 2012, 8, 2025. 2) Some of the commercial suppliers of flow photochemical reactors: Corning Inc. ([www.corning.com](http://www.corning.com)); Vapourtec Ltd. ([www.vapourtec.com](http://www.vapourtec.com)); Creaflow ([www.creaflow.be](http://www.creaflow.be)); Peschl Ultraviolet GmbH ([www.peschl-ultraviolet.com](http://www.peschl-ultraviolet.com)). 3) W. Matthew, S. Simon, H. Christian H. Australian Journal of Chemistry 2021, 74, 569-573.