Photochemistry in Flow

Vapourtec Ltd

The UV-150 Advanced Photochemical Reactor

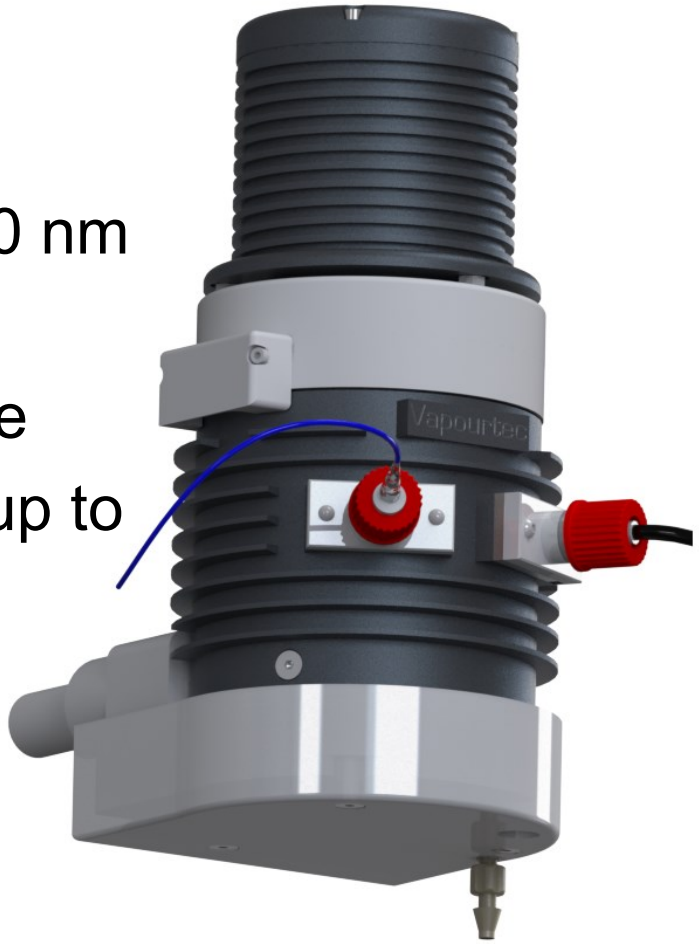
vapourtec

March 2014 Vapourtec launched the UV-150 continuous flow photochemical reactor

“Bringing photochemistry to the bench”

"What makes it special and how does it work?"

- Temperature control -40°C to 80°C
- Wavelength selection 250 nm to 700 nm
- Precise control of exposure time
- Safe, quick & easy to set up and use
- Efficient reactor design throughput up to 15 grams / hour



At the heart of the UV-150 is the compact reactor housing

"What's inside……."

Light sources available

Low pressure mercury– 3 options:

- 254 nm
- 310 nm
- 370 nm

Medium pressure mercury:

220 nm to 600 nm

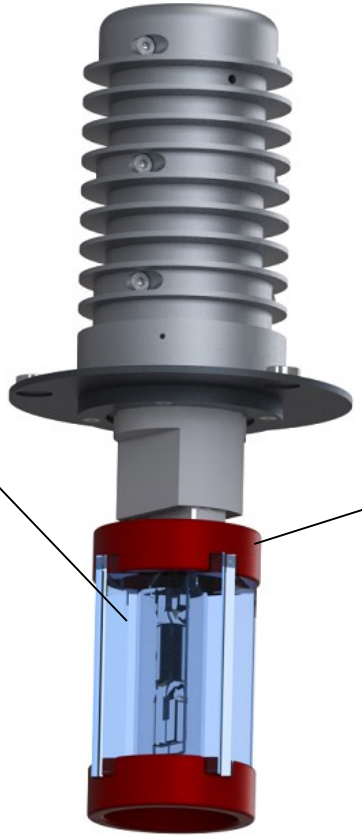
Filters to select desired wavelength

LEDs a range of precise wavelengths

365 nm to 700 nm

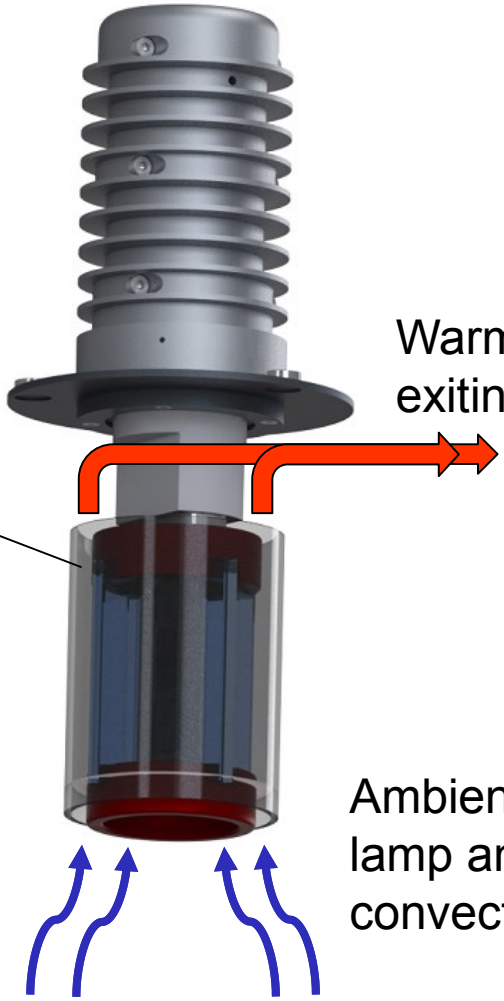
Reactor construction from centre out

Medium pressure mercury lamp



Filter used to select desired wavelength range (9 options)

Lamp and filter zone



Warm air vented safely after exiting lamp / filter zone

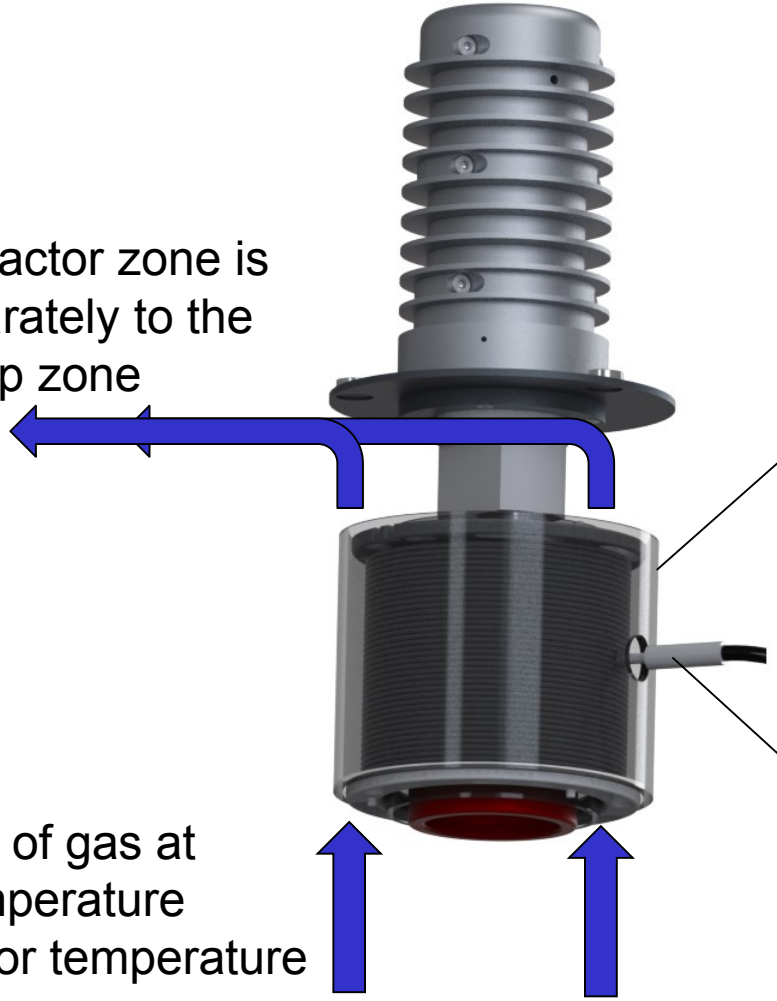
Quartz “barrier” tube

Ambient air used to cool lamp and filter by forced convection

Temperature control of the reactor zone

Compact reactor. 1.3mm bore fluoropolymer tube. Internal volumes 2 ml to 10 ml.

Temperature control of the reactor zone



Gas from the reactor zone is exhausted separately to the air from the lamp zone

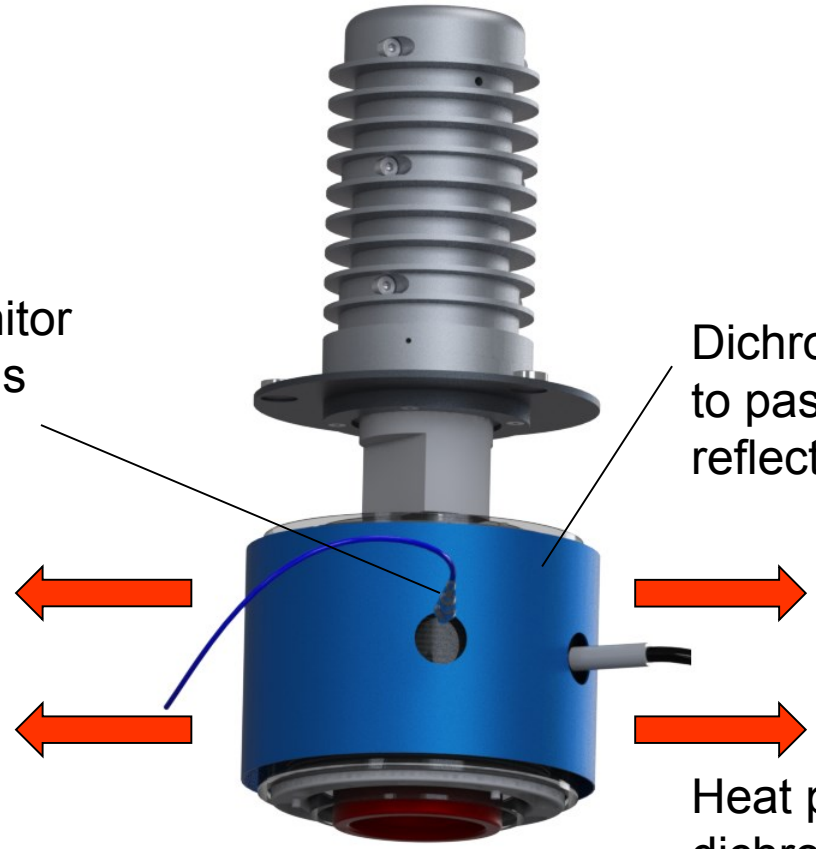
Quartz “outer” tube separates reactor from heat sink

Temperature sensor in contact with the reactor’s surface

High flow rate of gas at controlled temperature controls reactor temperature

Heat management in the UV-150

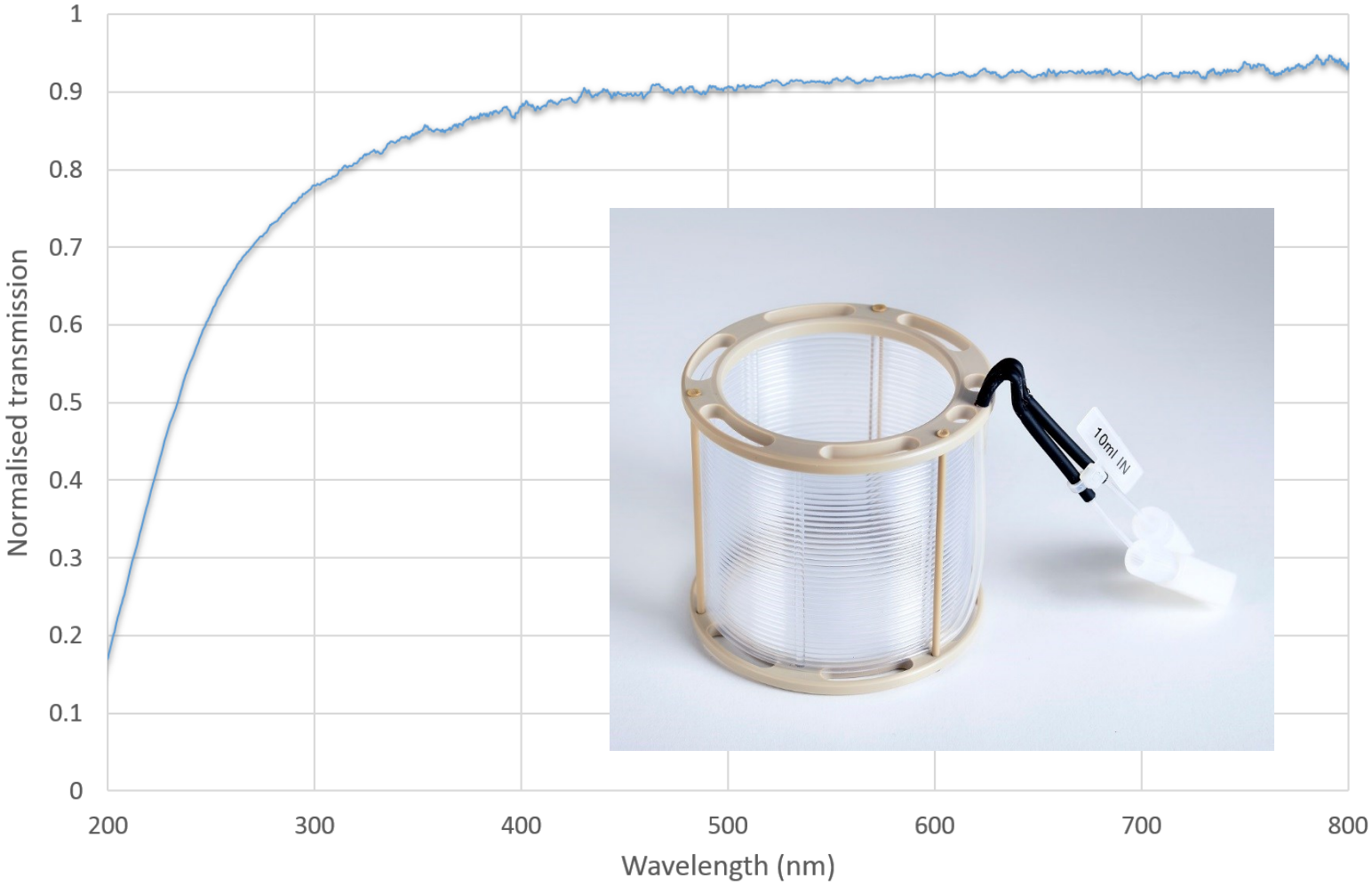
Optional fibre optic spectrometer to monitor absorption of photons during the reaction



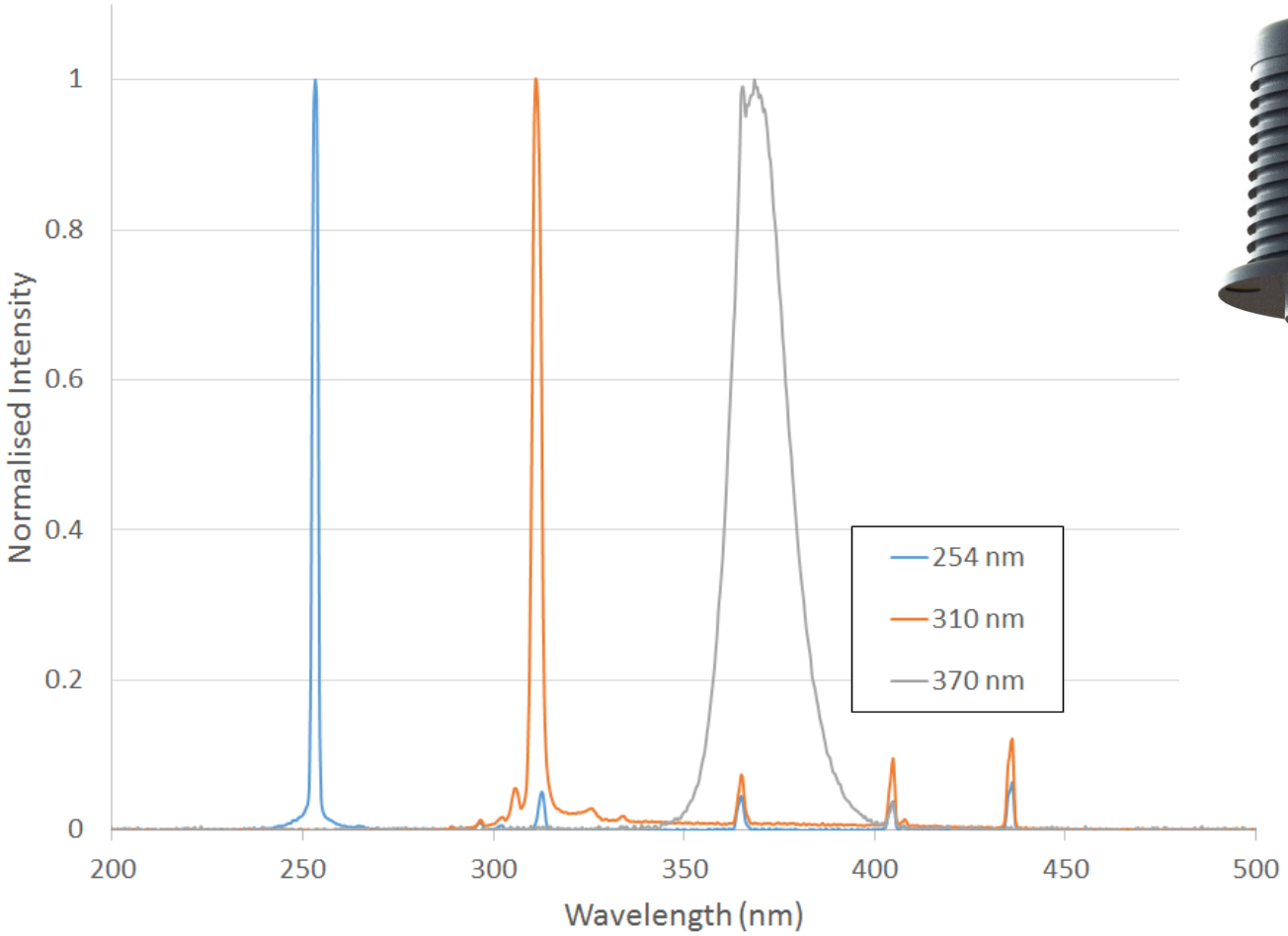
Dichroic mirror allows >450nm to pass through while reflecting UV wavelengths

Heat passing through the dichroic mirror is conducted away through the reactor body

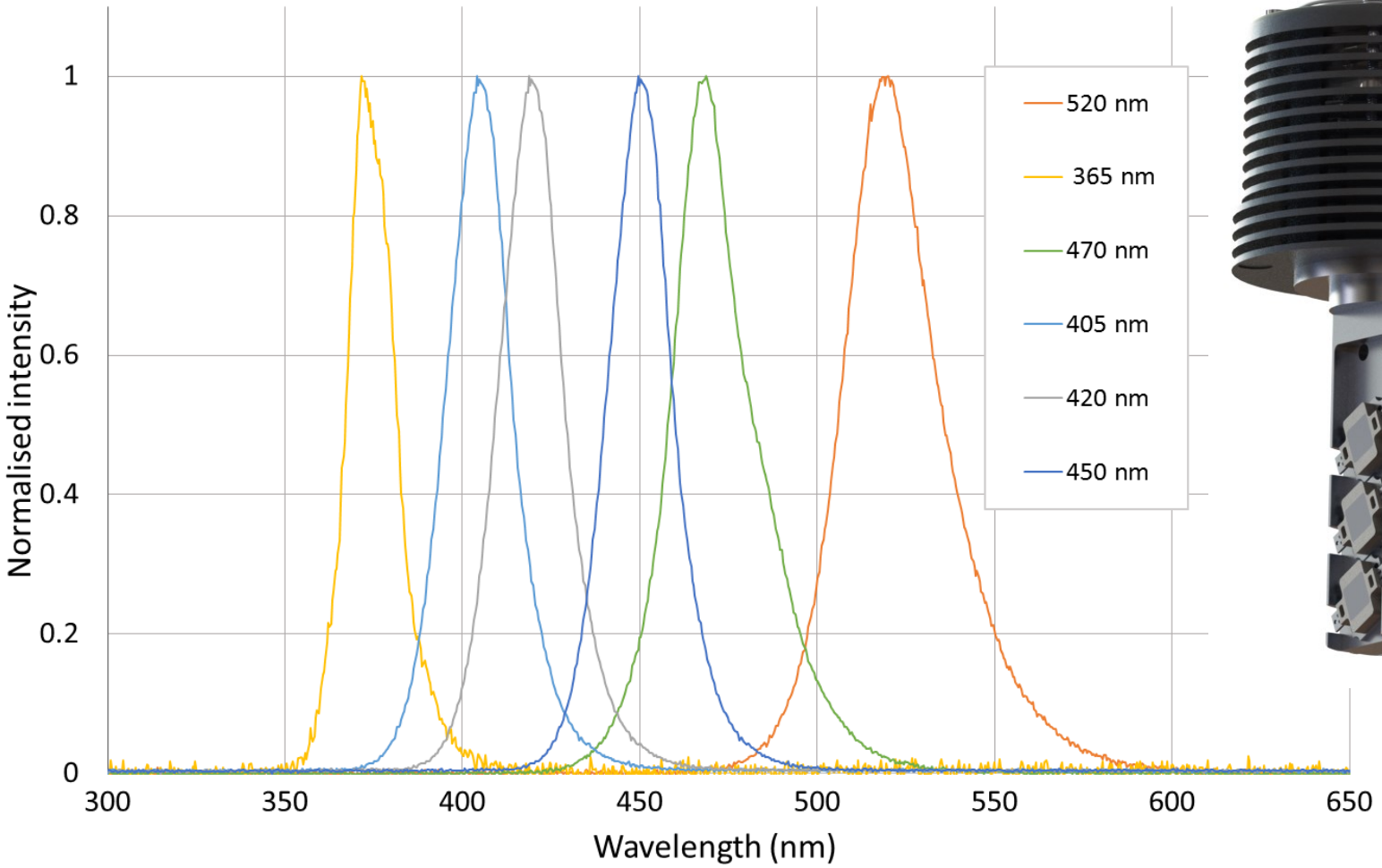
Transmission of the fluoropolymer reactor



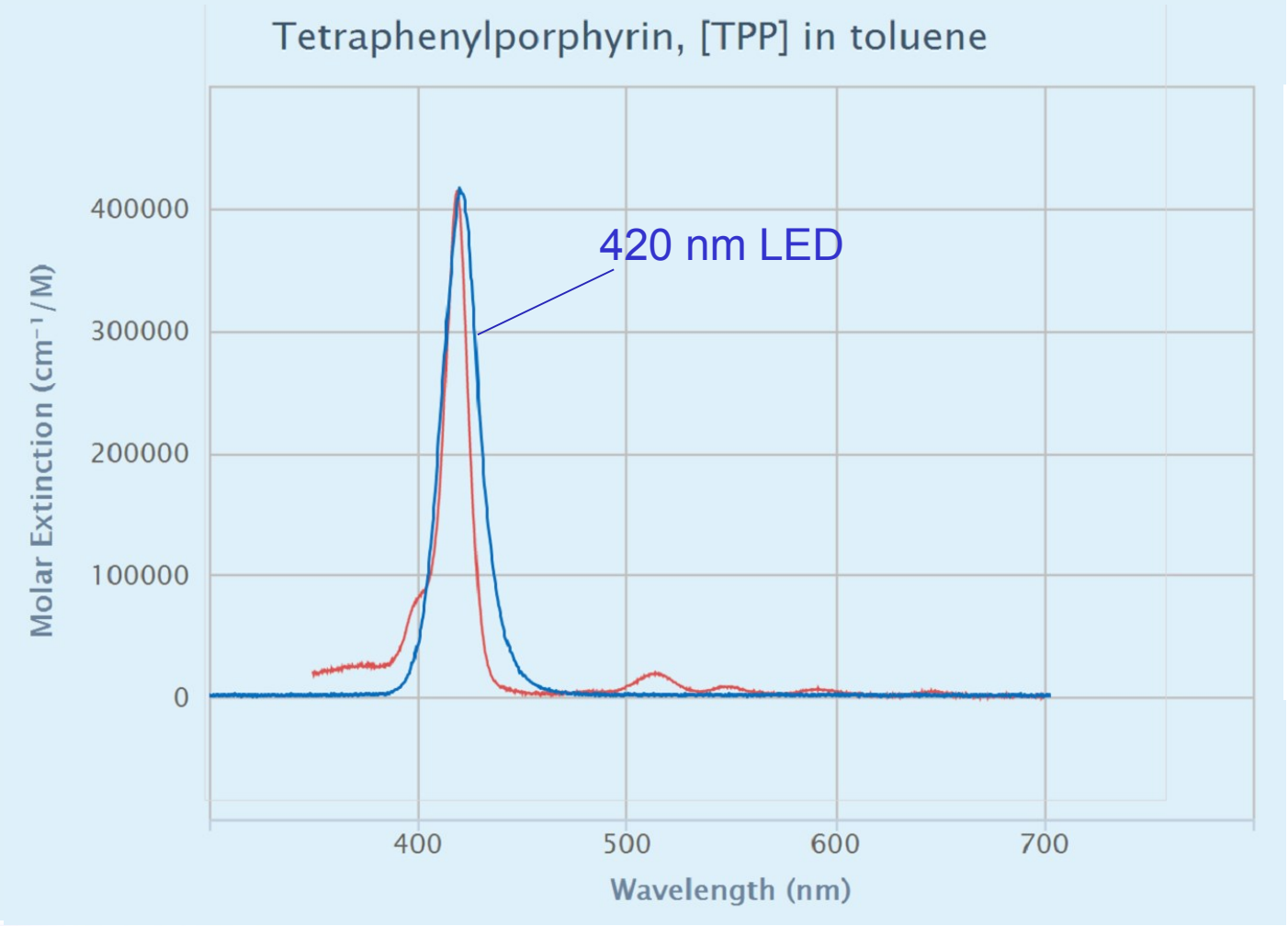
Low pressure mercury lamp (3 options)



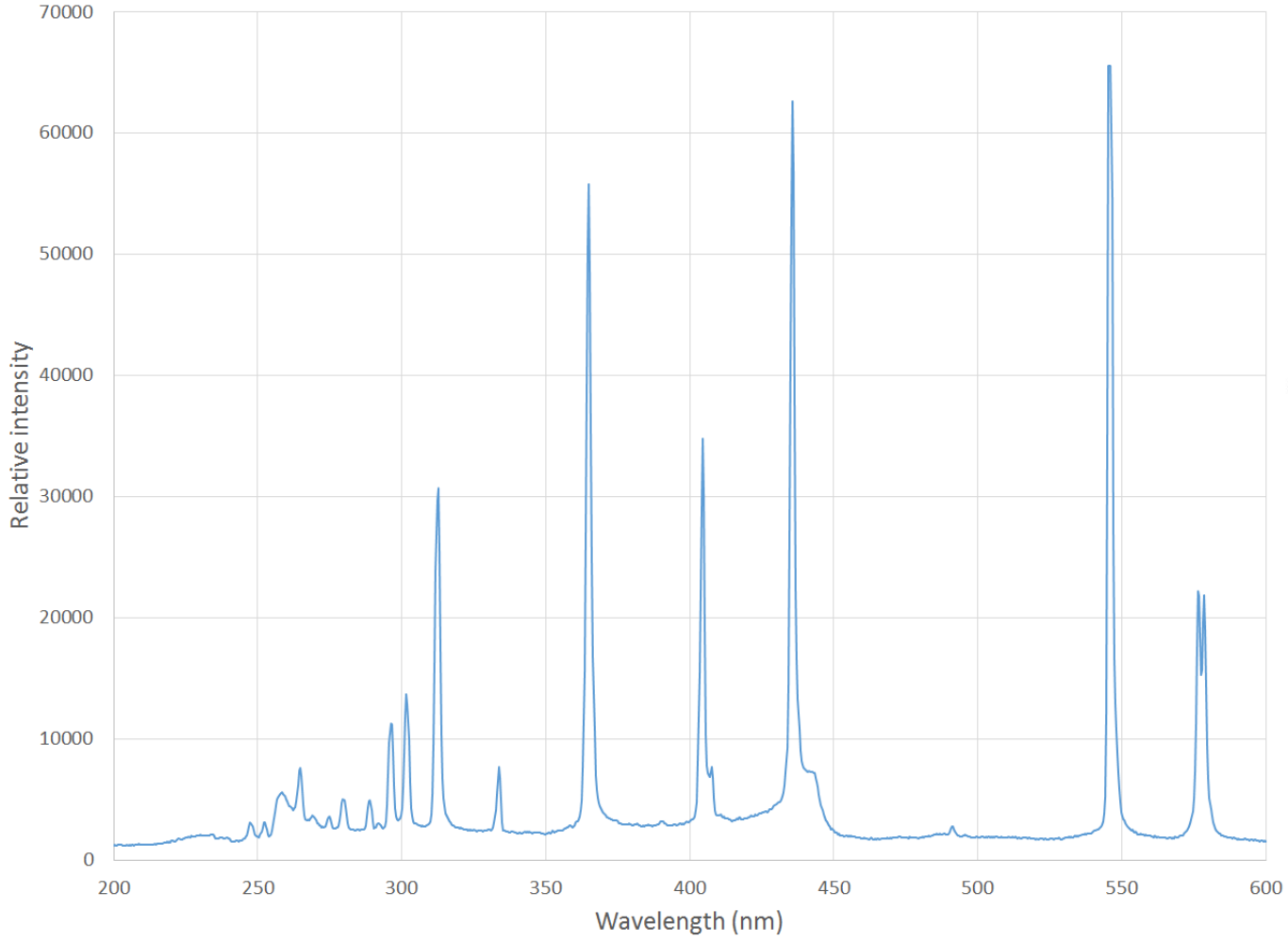
LED lamps (15 options)



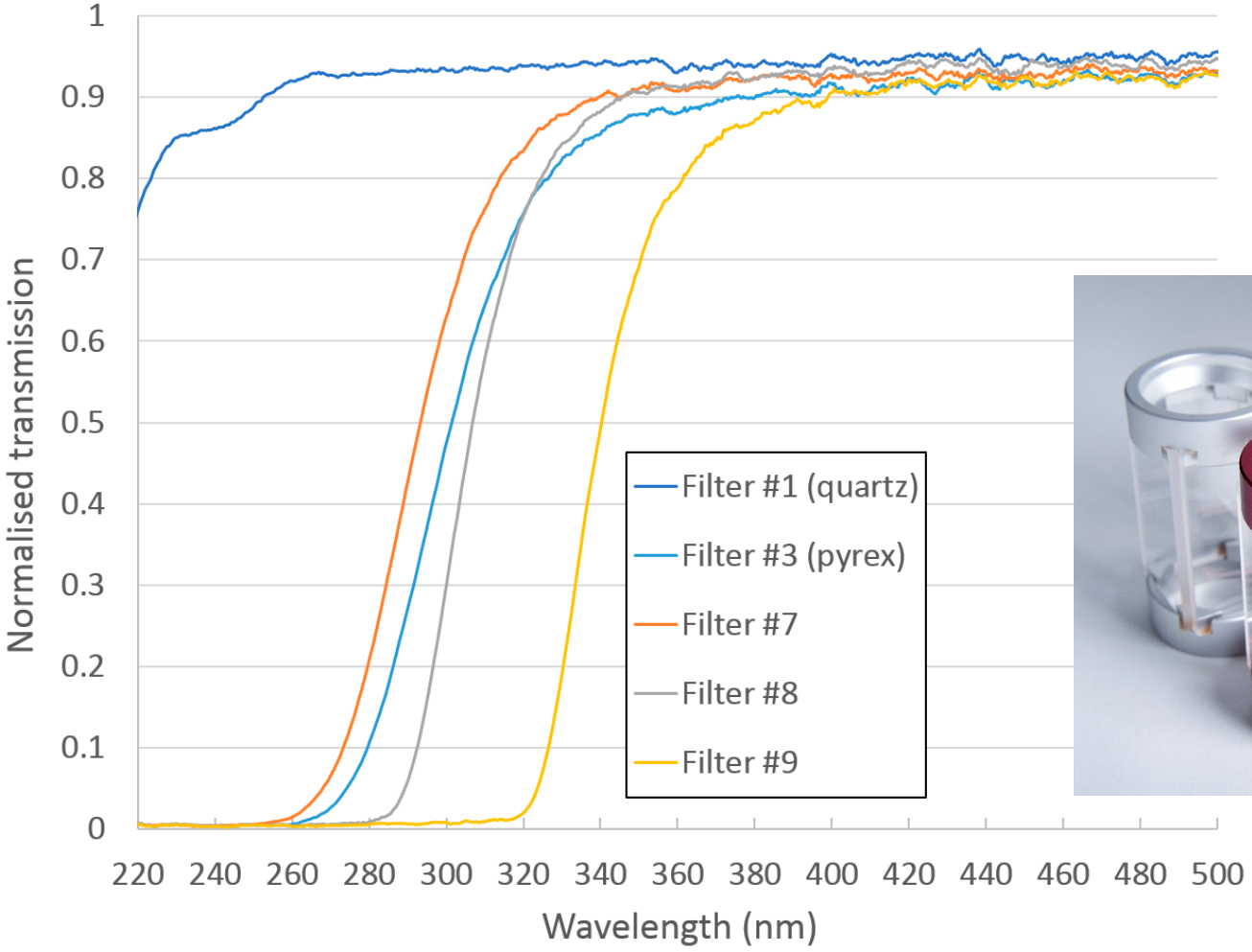
Matching LED wavelength to the catalyst



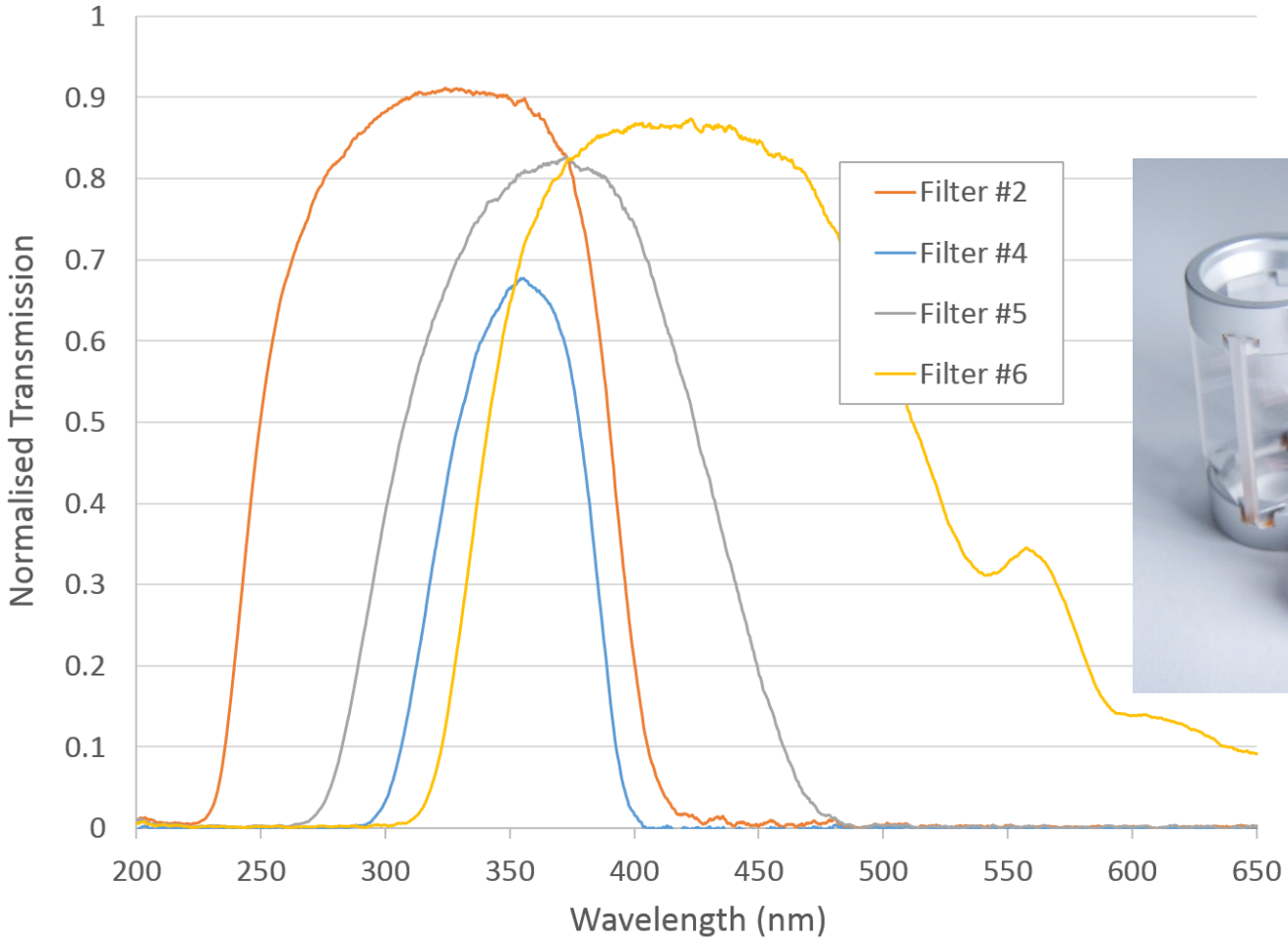
Pure mercury medium pressure lamp (unfiltered)



Comparison of long-pass filters (5 options)



Comparison of band-pass filters (4 options)



The UV-150 has been cited in diverse publications

Reevaluation of the 2-nitrobenzyl protecting group for nitrogen containing compounds: an application of flow photochemistry

Wendell, C. I., & Boyd, M. J. (2015). *Tetrahedron Letters*, *56*(7), 897-899.

Photodecarboxylative Benzylations of N-Methoxyphthalimide under Batch and Continuous-Flow Conditions

Pordanjani, H. M., Faderl, C., Wang, J., Motti, C. A., Junk, P. C., & Oelgemöller, M. (2015). *Australian Journal of Chemistry*, *68*(11), 1662-1667.

Light-Induced C - H Arylation of (Hetero)arenes by In Situ Generated Diazo Anhydrides

Cantillo, D., Mateos, C., Rincon, J. A., de Frutos, O., & Kappe, C. O. (2015). *Chemistry–A European Journal*, *21*(37), 12894-12898.

Batch and Flow Synthesis of Pyrrolo[1,2-a]-quinolines via an Allene-Based Reaction Cascade

Baumann, M., & Baxendale, I. R. (2015). *The Journal of organic chemistry*, *80*(21), 10806-10816.

From polymer synthesis to protection group removal

Photodecarboxylations in an advanced meso-scale continuous flow photoreactor

Josland, S., Mumtaz, S. and Oelgemöller, M. (2016), Chem. Eng. Technol., 39: 81–87. doi:10.1002/ceat.201500285

Continuous flow photo-initiated RAFT polymerisation using a tubular photochemical reactor

Gardiner, J., Hornung, C. H., Tsanaktsidis, J., & Guthrie, D. (2016). *European Polymer Journal*.

Automated glycan assembly of xyloglucan oligosaccharides

Dallabernardina, P., Schuhmacher, F., Seeberger, P. H., & Pfrengle, F. (2016). *Organic & biomolecular chemistry*, *14*(1), 309-313

Continuous photochemistry: the flow synthesis of ibuprofen *via* a photo-Favorskii rearrangement

Baumann, M., & Baxendale, I. R. (2016). *Reaction Chemistry & Engineering*

Researchers based geographically from Canada to China

Visible-Light Photoredox Catalysis using a Macromolecular Ruthenium Complex: Reactivity and Recovery by Size-Exclusion Nanofiltration in Continuous Flow

Guerra, J., Cantillo, D., & Kappe, C. O. (2016). *Catalysis Science & Technology*.

Continuous flow photochemistry as an enabling synthetic technology: synthesis of substituted-6(5*H*)phenanthridinones for use as poly (ADP-ribose) polymerase inhibitors

Fang, Y., & Tranmer, G. K. (2016). *MedChemComm*.

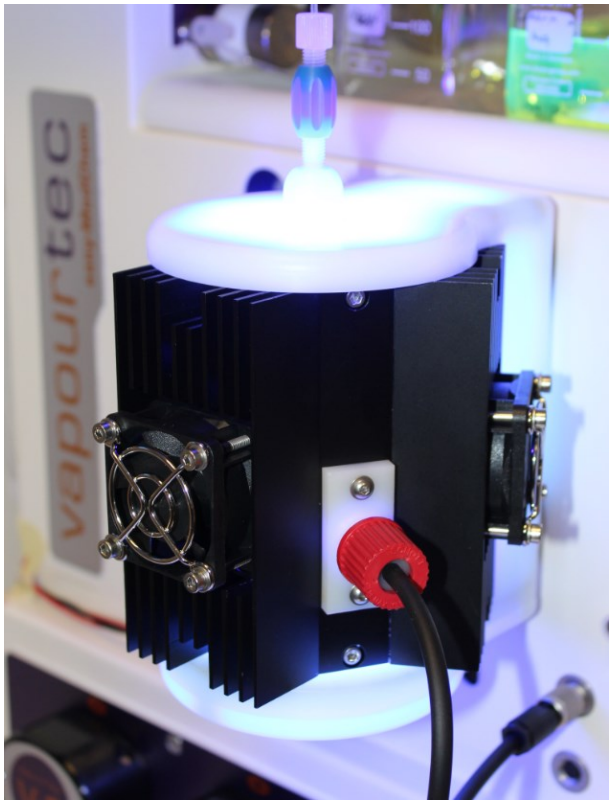
Photoactive and metal-free polyamide-based polymers for water and wastewater treatment under visible light irradiation

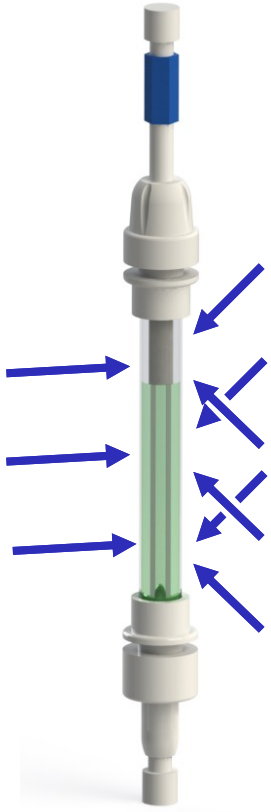
Shen, J., Steinbach, R., Tobin, J., Nakata, M. M., Bower, M., McCoustra, M., ... & Vilela, F. (2016). *Applied Catalysis B: Environmental*.

Efficient metal-free photochemical borylation of aryl halides under batch and continuous-flow conditions.

Chen, K., Zhang, S., He, P., & Li, P. (2016). *Chemical Science*.

Illuminating immobilised photo catalysts





- Illumination by LED applied around column
- Temperature control -20°C to 80°C
- Wavelength range 365nm to 700 nm

Another new photochemical reactor under development by Vapourtec Ltd.