ANZSMS Michael Guilhaus Research Award. – awarded July 2017.
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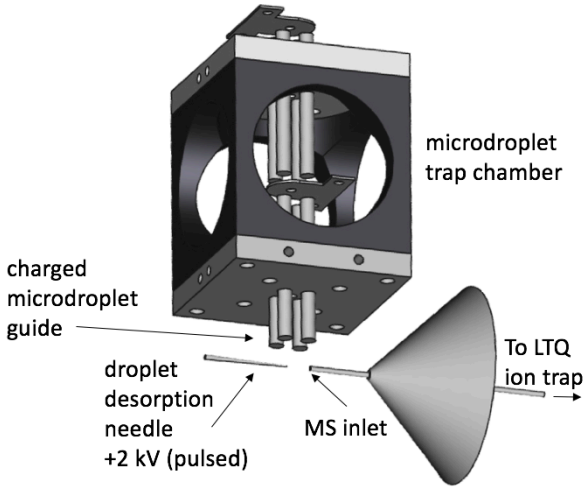
Project Title: Single-Microdroplet Levitation Interfaced with Online Ion-Trap Mass Spectrometry.

This project established a new experimental platform to probe photochemistry in single microdroplets. Off the back of previous work in the group where single microdroplets were investigated using a probe-needle based electrospray configuration [1] the idea of this project was to trap single droplets in an electrodynamic balance for extended periods (seconds, minutes and hours). At a chosen time, the droplet is released into the mass spectrometer. This would permit the study of droplet surface chemistry and photoactivated processes one droplet at a time.

Proposed droplet trap chamber and probe-needle desorption/ionisation source for mass spectrometry investigation of trapped droplets.



Although the experiment generally worked for short periods, it was not sufficiently stable to maintain conditions over longer periods. The probe-needle based source was also prone to contamination. Maintaining chemical conditions over hours of experimentation was too challenging.

New directions for this project now move away from microdroplet reactors and now utilise transparent capillaries and liquid chambers to initiate photochemistry within a few millimetres of an electrospray tip. This allows for the mass spectrometric investigation of photoreactions and interceptions of early-stage photochemistry. Current projects include an ARC Linkage Grant (with A and I Coatings) to provide information on the early-stage photochemistry of next-gen photoinitiators. So, the skills gained in external laser synchronisation with the internal timing of the mass spectrometer were vital in these developments. We are considering microfluidic options now too.

The funding provided by this award was invaluable directed to research project students allowing them to build up the requisite chamber and electronics associated with droplet trapping, electronics and power supplies for the electrodynamic balances and associated laser optics. This provided high-level of technical training for research students in chemistry and many technical aspects of innovative mass spectrometry.

https://youtu.be/clMLiN2aPPI

[1] P. J. Tracey, B. S. Vaughn, B. J. Roberts, B. L. J. Poad, A. J. Trevitt*, Rapid profiling of laser-induced photochemistry in single microdroplets using mass spectrometry, Anal. Chem. 2014, 86, 2895 (2014) DOI: 10.1021/ac403976q