2.035 Extractive Electrospray Ionisation Mass Spectrometry (EESI-MS) for organic aerosol analysis.

Early Career Scientist

Presenting Author:
Peter Gallimore, University of Cambridge, Department of Chemistry, Cambridge, UK, pjg48@cam.ac.uk

Co-Authors:
Chiara Giorio, University of Cambridge, Department of Chemistry, Cambridge, UK
Francis Wragg, University of Cambridge, Department of Chemistry, Cambridge, UK
Brendan Mahon, University of Cambridge, Department of Chemistry, Cambridge, UK
Paul Griffiths, University of Cambridge, Department of Chemistry, Cambridge, UK
Markus Kalberer, University of Cambridge, Department of Chemistry, Cambridge, UK

Abstract:

Organic compounds are ubiquitous in the troposphere and constitute a large fraction of aerosol mass. Characterising the composition of organic aerosols (OA) is key to understanding their formation, transformation and impacts on atmospheric chemistry and air quality. Here, we present a novel online technique for characterising OA, Extractive Electrospray Ionisation Mass Spectrometry (EESI-MS) [1]. EESI-MS employs gentle solvent-based capture and ionisation of aerosols. This generates molecular ions and allows individual aerosol species to be identified and monitored over time.

We will show that EESI-MS is an excellent tool for characterising OA generated in laboratory experiments, focusing on the quantitative abilities of the technique. Unlike related offline techniques, changes in EESI ion abundance provide a reliable measure of aerosol-phase concentration changes [2]. This “relative quantification” has been exploited in recent work to monitor composition changes during heterogeneous oxidation of oleic acid aerosols [3]. We extract previously unconstrained kinetic parameters related to condensed-phase reactions of Criegee intermediates using EESI-MS and process-based aerosol modelling.

Furthermore, we establish correlations between organic aerosol toxicity and chemical composition for OA formed from the prominent indoor pollutant and biogenic VOC, limonene [4]. We compare EESI spectra to complementary measurements of health-relevant reactive oxygen species (ROS). We find persistent levels of ROS are present in limonene OA, and hypothesise that the aerosol contains a reservoir of reactive species, including unsaturated compounds, which generate additional ROS over time.

[1] Gallimore and Kalberer, ES&T, 47, 7324-31, 2013.

[2] Gallimore et al., ACP, 17, 14485–500, 2017.
[3] Gallimore et al., JGRA, 122, 4364–77, 2017.
[4] Gallimore et al., ACP, 17, 9853–68, 2017.