

Profiling of Organic Matter in Submicron Aerosols using DRI Thermal Carbon Analyzer and Proton-Transfer-Reaction Mass Spectrometer

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Keywords: Aerosol measurement techniques (INST), Aerosol speciation, SOA formation

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We present here a rapid, organic solvent-free and robust offline method for assessing the organic composition of ambient particulate matter using the combination of a modified DRI thermal carbon analyzer and a Proton-transfer-reaction Mass Spectrometer (PTR-MS) (see figure 1). Five typical organic tracers in aerosol phase, which include phthalic acid, levoglucosan, arabitol, cis-pinonic acid and glutaric acid, were utilized to examine the response of the tandem instruments against a wide range of mass concentration. Results indicated that the PTR-MS can efficiently account varying mixing ratios of organic markers, even at low and atmospherically relevant concentrations.

In addition, the organic composition of submicron aerosols from a subtropical urban aerosol observatory in Taipei, Taiwan was investigated. Figure 2 shows the time series profiles of total mass concentration of organic matter (TOM) obtained using this technique and from DRI-thermal carbon analyzer. Analysis of the TOM concentration indicated that the tandem instrument of this study underestimated the measurements from a typical thermal/optical carbon analyzer by 27%. The unaccounted organic matter was attributed to unwanted side reactions such as pyrolysis and combustion, as well as the condensation of compounds with low vapor pressure in the transfer lines.

Moreover, the survey of the major peaks/compounds in the mass spectrum revealed that carboxylic acids such as phthalic, glutaric and acetic acid dominated the organic aerosols mass concentration. The measurements here suggested that low molecular weight carboxylic acid (LMWCA), which are products of photochemical oxidation of gaseous hydrocarbons and fatty acids, constituted a major fraction of secondary organic aerosols in Taipei, Taiwan, a typical subtropical urban area. With this protocol, the remaining unassigned organic compounds can be possibly resolved into specific molecular entities, complementing the previously reported methods (i.e. GC-MS) on profiling the organic aerosol matrix.

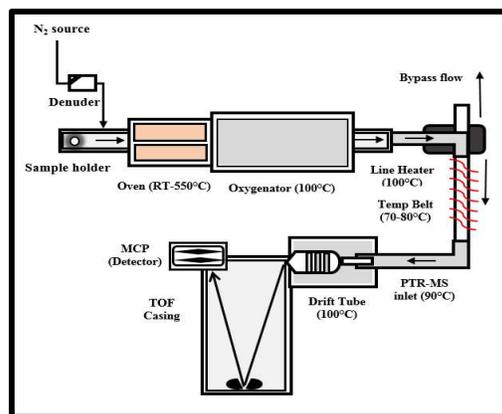


Figure 1. Schematic diagram of the tandem instruments. Included also here are the relevant instrument settings used in this study.

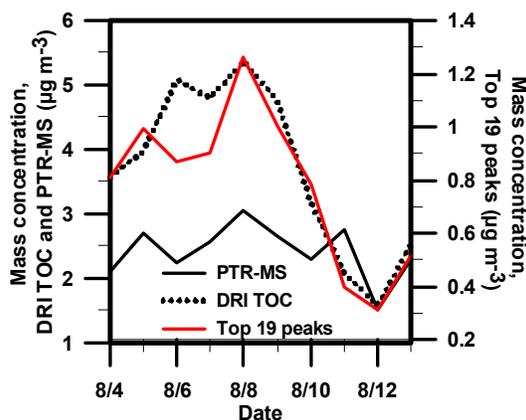


Figure 2. Time series profile of total organic matter (TOM) measured using DRI OC/EC and PTR-MS, including the major peaks observed in the mass spectra.

This study was supported by the Academia Sinica and the Ministry of Science and Technology of Taiwan through grants 104-2119-M-001-010, 103-2111-M-001-003, and 102-2628-M-001-007.