GC×GC-(HR)TOFMS : FROM EXPECTATIONS TO PRACTICAL APPLICATIONS

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It all started in 1991 [1]. On-column thermal modulation comprehensive two-dimensional gas chromatography (GC×GC) was invented and, a few years later, started to generate interest in in a larger audience that formerly met during the First International Symposium held in March 2003 in Volendam, the Netherlands. Early 2018, more than 1,600 papers reporting on the use of GC×GC have been published [2]. From the early days where GC×GC was exclusively reserved to a somewhat 'closed' group of practitioners and perceived as a very complex technique, it slowly opened to a larger world and started to be more mature and more widely used to solve practical issues faced by the Separation Science community. The development of several robust modulation devices, the efficient coupling to mass spectrometry, the commercial availability of several complete systems from different manufacturers, and, slowly, the accessibility to less exclusive and more versatile software solutions were important milestones.

For the last 15 years, we have been pushing the technique, especially when coupled to time-of-flight mass spectrometry (TOFMS), in several fields of application. Our early work on Persistent Organic Pollutants (POPs), including PCBs, OCPs, PBDEs, and dioxins allowed us to demonstrate the separation power of GC×GC chromatographic resolution and TOFMS deconvolution for qualitative and quantitative analyses in biological matrices at the low picogram level [3,4]. Even the entire set of the 209 PCB congeners was nearly separated [5]. The cryogenic zone compression (CZC) effect of the modulation was also used to attain unprecedented attogram sensitivity for dioxin measurements [6]. A more recent field of investigation has been untarget volatile organic compound (VOC) measurements in a variety of applications such as forensics, metabolomics, breath analyses, beer analyses, tobacco combustion, petroleomics, archeometry, … In forensics, GC×GC-TOFMS contributed to a better description of cadaveric decomposition volatile profiles, strengthening VOC data for possible court usage [7]. Important data processing considerations resulted from these experiments, especially in terms of alignment, data reduction, data supervision, and visualization [8]. Large cohort studies in cancer research and metabolomics impacted the way we statistically process our extensive matrices of data. Several GC×GC-TOFMS medical applications are now moving up in technology readiness level (TRL) scale, especially when HRTOFMS is used to strengthen analyte identifications.

No doubt that GC×GC came a long way. No doubt either that GC×GC still has to be further mastered, especially in terms of data processing, to offer fully usable data sets…

Reference

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