CZC-GC miniaturized analysis of POPs in 20 µL blood

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Humans all over the world are exposed to chemicals during their life time. Among the thousands of existing anthropogenic compounds are the persistent organic pollutants (POPs), including compounds like polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), but also a large number of new molecules like halogenated flame retardants (HFRs). Nowadays, POP (temporal) human biomonitoring is classically performed on serum specimen. Typically, 5-75 mL of whole blood are sampled from patients and analyzed by state-of-the-art GC isotope dilution (ID) sector HRMS. Even if much less invasive than the classical surgical abdominal fat removals that were performed in the 1980's, the venipunction of several milliliters of whole blood for analytical purpose is still badly perceived by patients.

The aim of the work is to develop and miniaturize an analytical strategy based on cryogenic zone compression (CZC) of chromatographic signals for the analysis of selected POPs in 20µL whole blood. The method can be considered as (almost) non-invasive since samples are simply prepared by pricking the heel or the finger to collect a few drops of blood.

The procedure was partially automatized using micro-extraction by packed sorbent (MEPS) for sample preparation and a GC×GC high-resolution (HR) time-of-flight (TOF) mass spectrometer (MS) for fast analysis. MEPS extraction, which was the key part of the development, led to clean spectrum without further clean up. The miniaturization was pushed to its limits since the total amount of solvent used was as low as 500µL.

The GC×GC instrumentation is used in the cryogenic zone compression (CZC) mode, particularly suitable for low level target analysis with extreme enhancement of signals. Search for unknown and/or emergent compounds is also investigated, thanks to both the large chromatographic separation space available and the analytical power of the TOFMS instrument.