



# Gas chromatographic determination of volatile compounds

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Gas chromatography (GC) is an analytical technique for the quantitative determination of volatile compounds, and GC is widely used in practical fields, such as food, environmental, forensic, and pharmaceutical analysis. GC was first introduced by A.T. James and A.J.P. Martin in 1952, which describing separation of fatty acids by gas–liquid partition using a liner glass tube of 1.2 m long  $\times$  4 mm internal diameter [1]. After that, Golay introduced the theory of open tubular column (capillary column) in 1958 [2].

Detector is an important component in GC for highly sensitive determination, and various types of detectors are developed. Recently, a novel detector using low-temperature helium ionization, named barrier discharge ionization detector (BID), has been developed. BID can detect all the volatile compounds except helium and neon with higher sensitivity than flame ionization detector (FID) [3]. Hence, BID can be suitable for detection of low-molecular weight compounds, such as ammonia [4] and formic acid [5]. The FID response is proportional to the number of carbon atoms, although is also affected by other atoms, such as N and O. The introduction of a post-column oxidation/reduction system has enabled the simultaneous determination of 23 volatile compounds with a single reference [6].

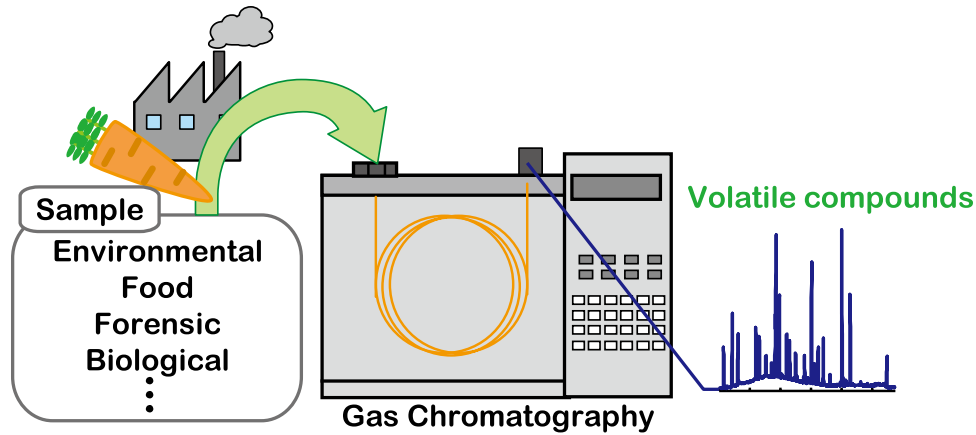
Adequate sample preparation and preconcentration steps are very important in GC determination. Solid-phase microextraction (SPME) is one of the most promising sample preparation methods for extraction of volatile organic

compounds (VOCs) from complex matrices. SPME is a solvent-free and simple extraction technique. SMPE has, however, disadvantages of the low extraction and fragile phase. To overcome these disadvantages, SPME arrow has recently been developed and commercialized [7]. A needle-type extraction device is also a solvent-free VOC extraction method. The device includes a particulate extraction medium in a stain-less steel needle [8, 9]. Target VOCs are adsorbed on the adsorbent by active sampling of a gaseous sample, which is then inserted directly into the heated GC inlet for desorption. The method was applied to determination of VOCs in both air samples [10, 11] and aqueous ones based on the purge and trap extraction [4, 12]. A solid-phase extraction (SPE)-type extraction device has also been reported for extraction of VOCs in the air. The extracted VOCs are completely eluted from the cartridge by passing small amount of organic solvent. Therefore, the method does not require withdrawal of the adsorbent and an expensive instrument [13, 14]. Other sample preparation methods are well-summarized in a review article [15].

Component analysis of fine particulate (PM<sub>2.5</sub>) in atmospheric air is important for understanding origin of PM<sub>2.5</sub> and its effect to human health. GC–MS analysis is used for determination of organic component included in PM<sub>2.5</sub> [16, 17]. Pyrolysis–GC is also being developed for polymer characterization [18].

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