Analysis of Atmospheric Samples using a Comprehensive Two-Dimensional Gas Chromatograph Coupled to a Time-of-Flight Mass Spectrometer

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The method of Comprehensive Two-Dimensional Gas Chromatography (GC×GC) coupled with Time-of-Flight Mass Spectrometry (TOFMS) has gained considerable attention in recent years for the broad analysis of organic compounds. The breadboard design of a GC×GC-TOFMS system using a pre-concentration unit for sampling of Volatile Organic Compounds (VOC) in the atmosphere will be described and preliminary results from a recent field campaign will be presented.

The sample material is collected on a multi-bed pre-concentration unit before its injection as a narrow vapor plug into the separation (GC×GC) and identification (TOFMS) system. The GC×GC system consists of a serial arrangement of two GC columns connected by a thermal modulator. The first column separates components based primarily on their volatility, whereas the second column with a polar stationary phase separates the sample material based on its polarity. The thermal modulator is a key component in this arrangement and uses a closed loop, air-cooled, and resistively heated dual stage design at the junction of the two separation columns. The breadboard instrument has been operated with a Flame Ionization Detector (FID) and alternatively with the TOFMS system. The TOFMS employs an ion source with electron impact ionization and orthogonal ion acceleration, a reflectron, and a multi-channel plate detector.

The instrument has been deployed at the University of Michigan Biological Station (UMBS) in northern Michigan for the analysis of VOC's collected directly above the canopy of the forest. The results with an emphasis on technical aspects will be presented.