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# Systems for Plant Volatile Organic Compound (VOC) Analysis

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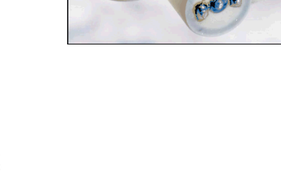
## Plant VOCs as Sensor Targets

Plants generate VOCs in response to both biotic and abiotic stressors. These compounds are central to their inter (microbe, avian, insect) and intra species communication strategies. Their biosynthesis pathways make natural targets for genetic manipulation. This signaling can be harnessed to produce natural amplification, such as when herbivory alarm VOCs are detected and generated by nearest neighbors.

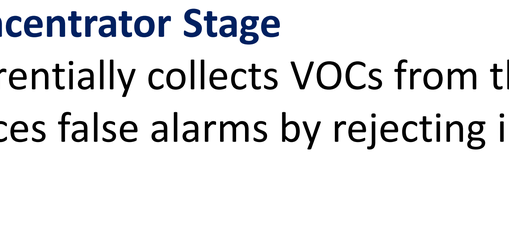
## VOC Sensing System Concept



**Plant VOC Sources**

- Leaves
- Roots
- Flowers

**UAV Collection**



**VOC Capture for Laboratory Analysis**

- Inexpensive platform and gold standard analysis
- Use Sandia's µSamplers or conventional collection tubes



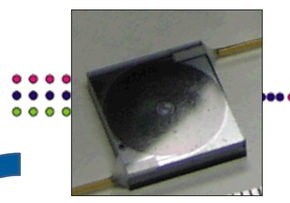


**Field VOC Sensing**

- Rapid results and survey of large areas
- More expensive platform and deployment costs

**Preconcentrator Stage**

- Preferentially collects VOCs from the environment.
- Reduces false alarms by rejecting interferents.

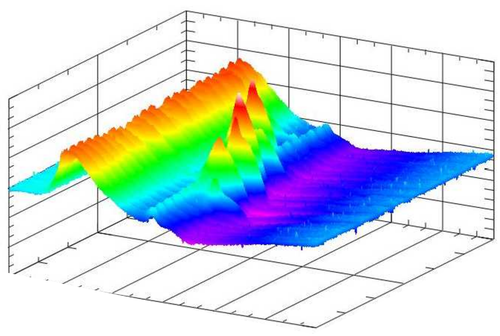


**Separation Stage**

- Separates complex chemical mixtures in time.
- Increases analysis confidence by allowing chemical identification.

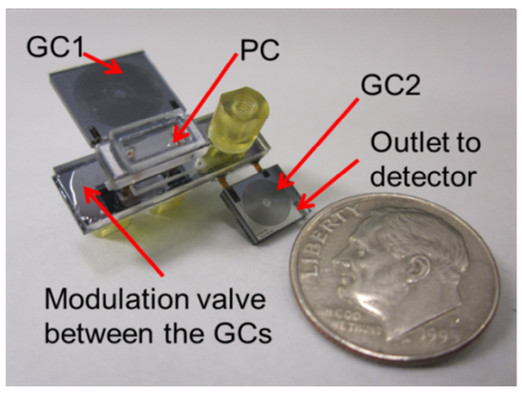
**Detector Stage**

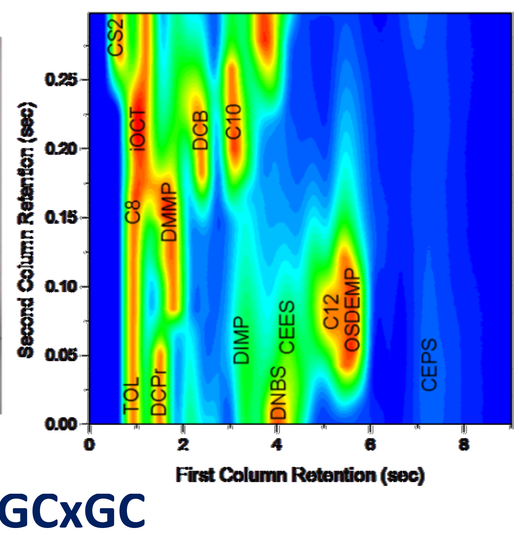
- Sub ppb sensitivity



**Identification of VOCs by GC/positive mode IMS**

## Unique Enabling Technologies from Sandia

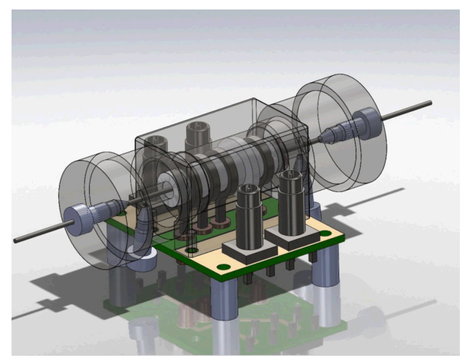



### Separation Stage- Micro GCxGC

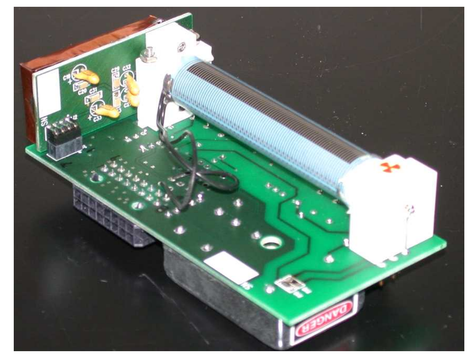
The GC channels are microfabricated in a tight spiral coil on a silicon chip allowing GC1 to be 1 meter long and GC2, to be 30 cm long. At right is a two dimensional microGCxGC separation of 14 chemicals in under 10 seconds. This comprehensive separation of complex chemical mixtures requires no a priori knowledge of the target environment. Air can also be used as the GC mobile phase to eliminate consumables, but will result in a longer separation time.

### Detector Stage- Pulsed Discharge Ionization Detector



Uses a localized helium plasma to generate high energy photons which will ionize nearly every compound except neon. Collected charge forms the detector's signal, allowing for excellent parts per billion (ppb) to parts per trillion (ppt) sensitivity. A high dynamic range detector that requires a helium consumable.

### Detector Stage- Miniature Ion Mobility Spectrometer



Sandia has developed a miniature correlation IMS system for the detection of explosive compounds. This system has seen extensive field testing and is shown to detect picogram quantities of explosive compounds. Recent testing has demonstrated the ability of this system to also detect a wide range of VOC targets.

### VOC Capture Stage- µSampler

Inert, low SWAP, and evacuated sample volumes. Captures and stores pristine environmental samples.