

# VOCs as Early Symptomatic Markers

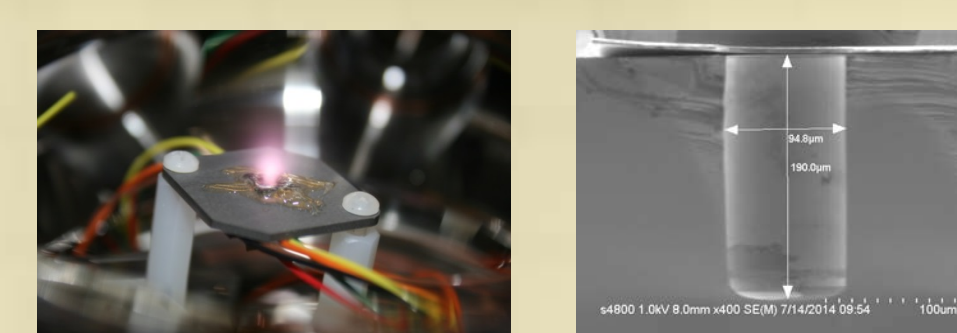
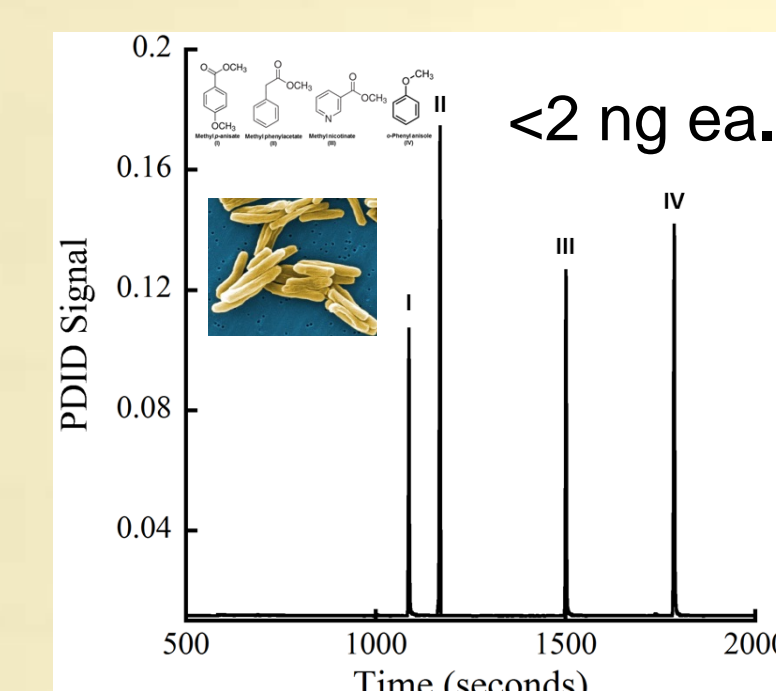
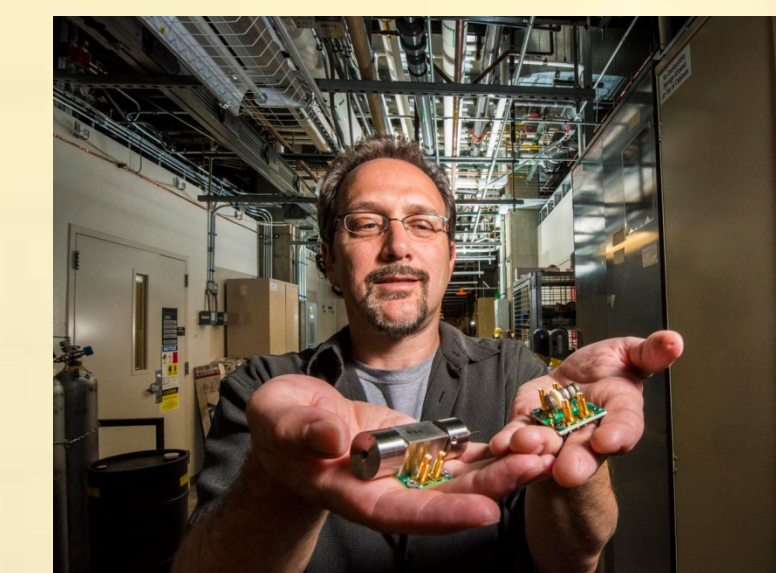
Ron Manginell, Ph.D. rpmangi@sandia.gov

## Volatile Organic Compounds (VOCs) diagnostic of disease

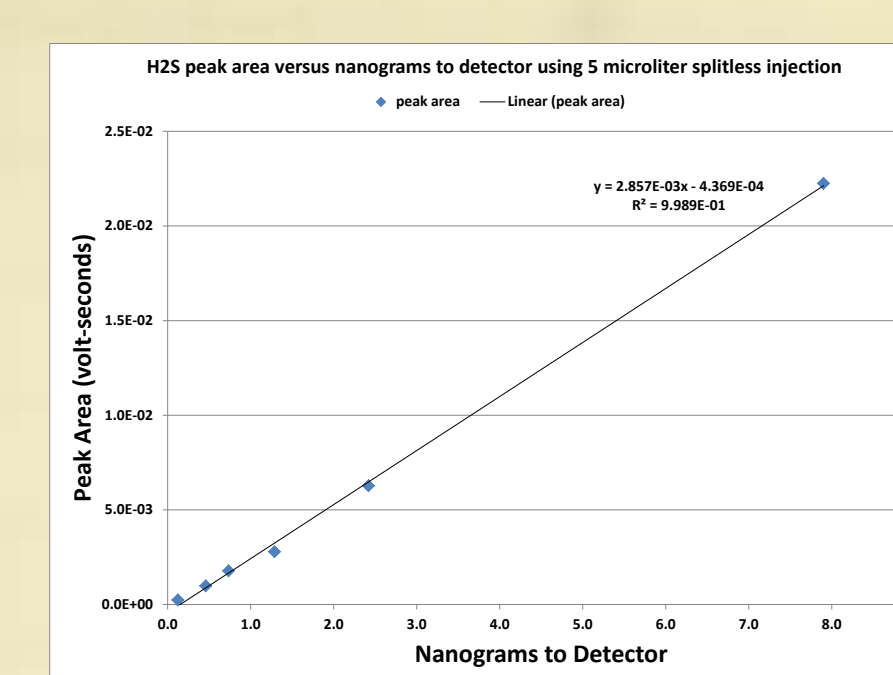
**Motivation:** Biology smells. That is, it produces characteristic odors. Specific biological VOCs & patterns of BioVOCs have been used to identify bacterial & viral diseases, metabolic disorders, etc, pre-symptomatically by using lab gas chromatography, mass spectrometry (GC/MS) & statistics. Lab-identified BioVOCs can be used in Point-of-Care (POC) diagnosis given suitably high performance. Sandia has demonstrated microGC detection systems with the performance needed for identifying early symptomatic BioVOC markers.

## New BioVOC Detector

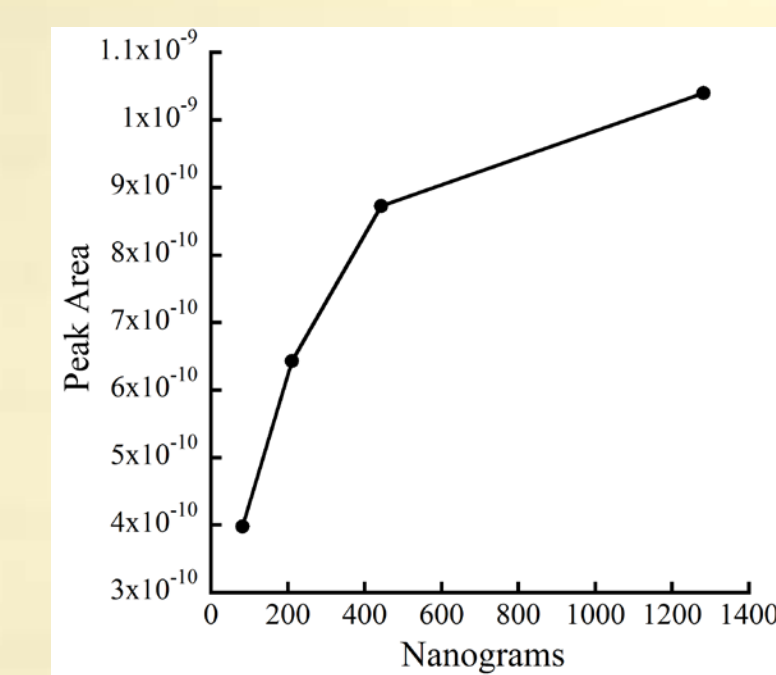
- Mini pulsed discharge ionization detector - plasma photo-ionization
- Sensitivity comparable to benchscale MS for TB VOCs
- No compromises with size, no vacuum pumps needed for mini-MS;
- Further miniaturization with Microplasma LDRD



Microplasmas for next gen PDID

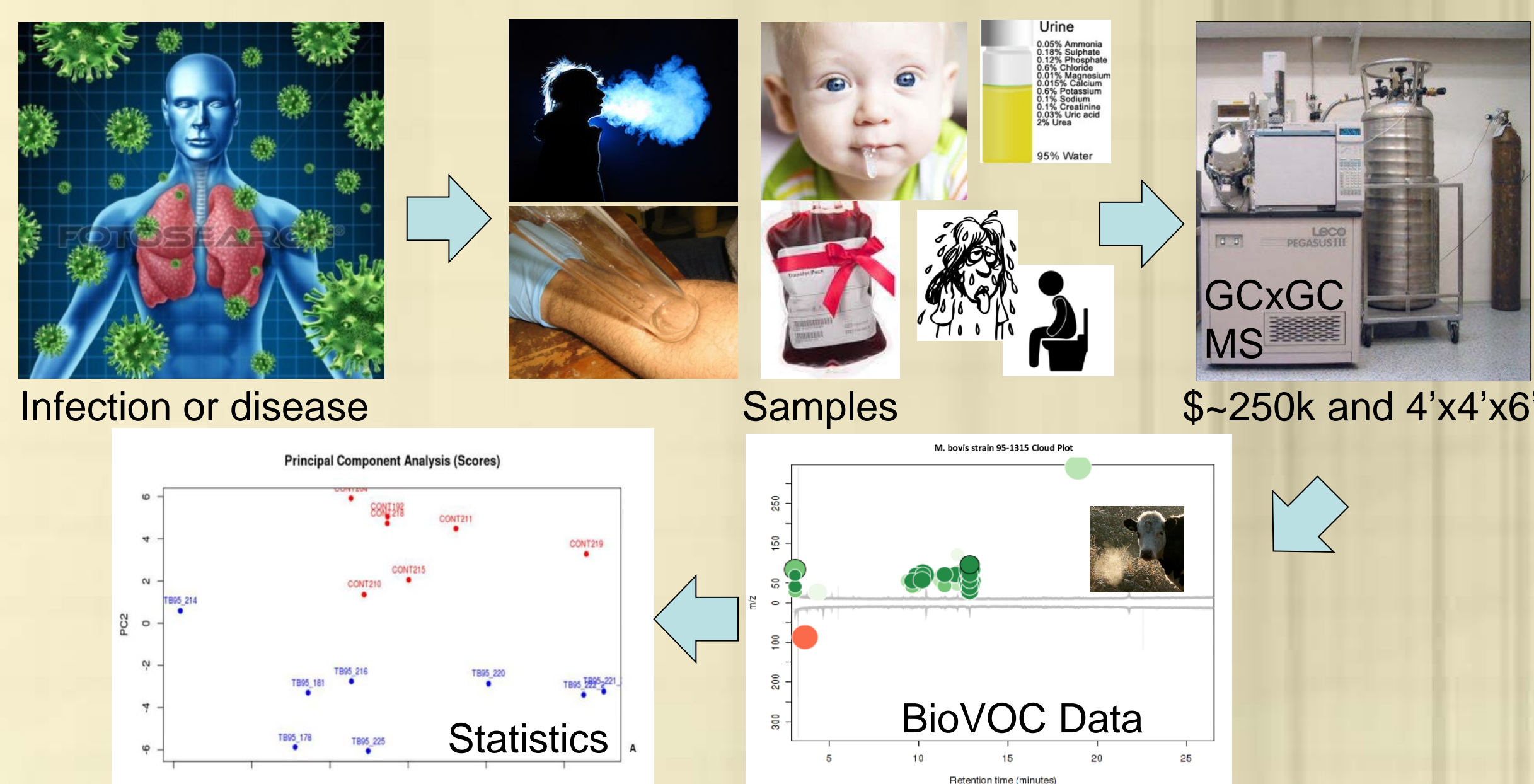


GC/PDID detection of H<sub>2</sub>S: Stress indicator, toxic industrial chemical & BioVOC



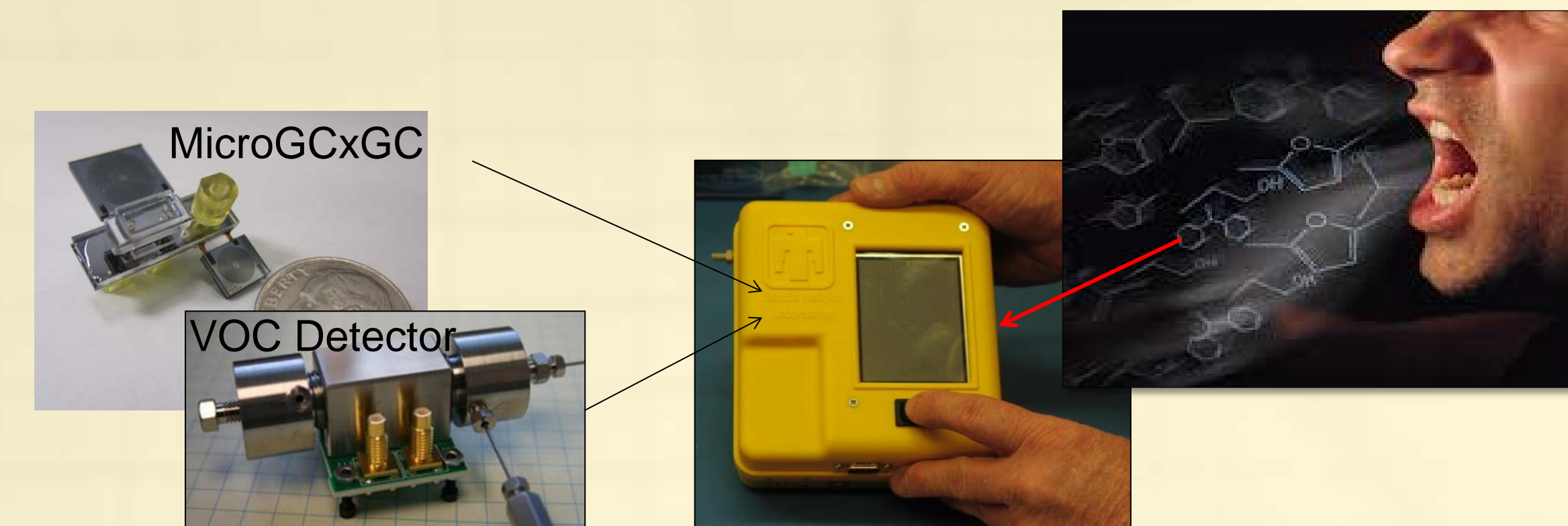
GC/PDID detection of hexenoic acid: BioVOC produced by skin bacteria

## Diagnostic BioVOCs today



Example: Exhaled cattle breath by GC-MS, PCA, LDA to distinguish healthy calves from calves with *M. bovis* infection with sensitivity and selectivity of 97% and 99% C.K. Ellis *et al*, PLoS ONE, 9: e892280, 2014.

## Taking this to the field or clinic of the future



High-Performance MicroGC-Based Analyzer for Early BioVOC Markers: Taking high-performance lab techniques to the clinic affordably

## Sandia's Point-of-Use VOC Detection Paradigm

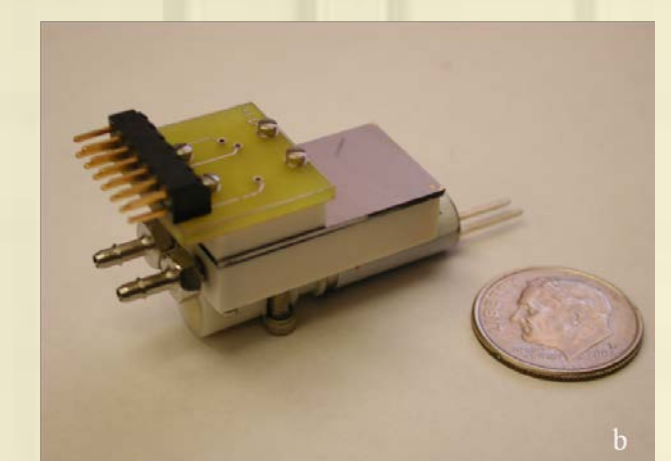
- Portable, affordable, push button
- Rigorous field chemical agent tests
- Boston subway, no false alarms in 22 months, 450,000 analyses
- Sub-ppb in real ambient
- MicroGCxGC: 50 peaks/sec
- Investment in chemical detection turning towards BioVOCs with recent investments



MicroChemLab



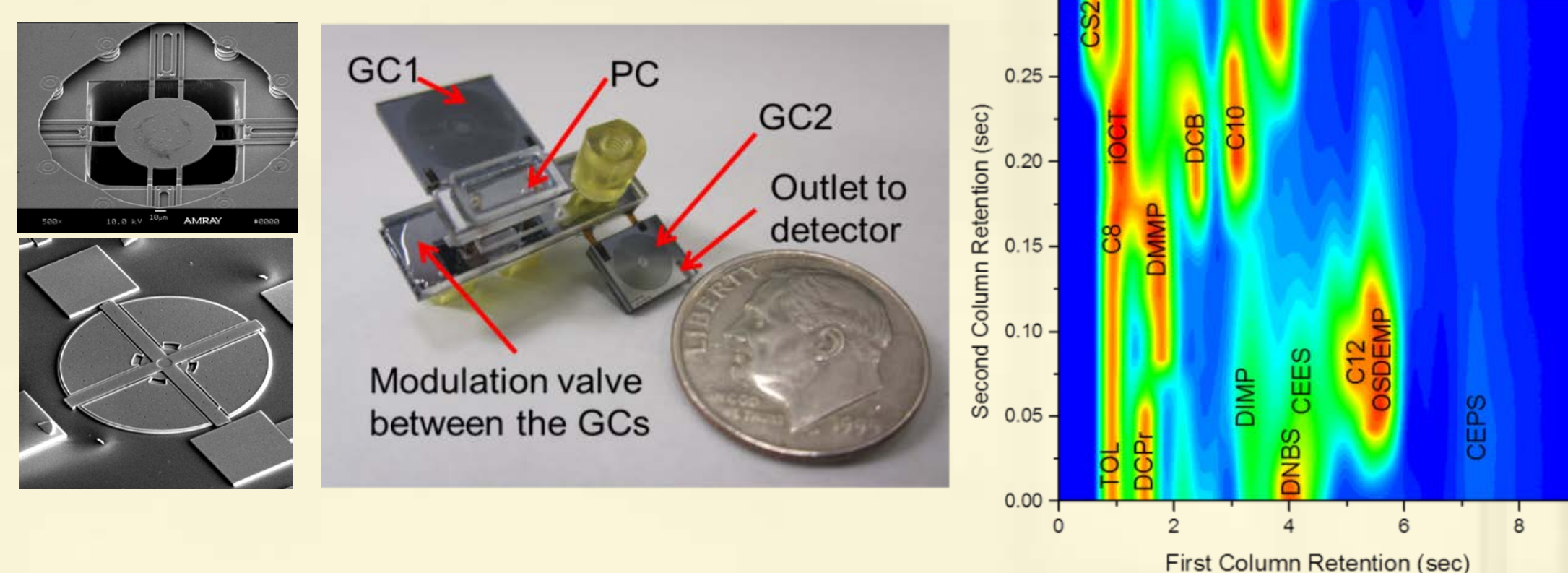
Subway Tests



Wearable



PDID VOC Detector



MicroGCxGC: Sample Precon, Valve, Dual GC and >50 VOC/sec

## New Apps & Summary

- Metabolic disorder detection
- Crop growth and health
- LDRD proposal on early detection of pond collapse
- Food safety, microbiome, sepsis, human performance....
- BioVOCs as early diagnostics
- FDA approved breath tests
- Non-invasive, non-contact
- High-performance, low cost required
- SNL systems meet requirements & can detect chemical agents also
- No detector compromises



Forearm BioVOC collection

