

Microfabricated GC for Sub-PPB Determinations of TCE in Vapor Intrusion Applications

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The development of a fully functional microfabricated gas chromatograph (μ GC) for the determination of low-/sub-ppb levels of TCE in indoor air for vapor intrusion (VI) applications is described. The essential components of the μ GC are a micro-preconcentrator/focuser (μ PCF), micro-columns for chromatographic separations, and an integrated array of four chemiresistor (CR) microsensors for detection. The combination of chromatographic retention time with the response patterns for each analyte provided by the CR array increases the reliability of TCE determinations in the presence of co-contaminants. In order to achieve the low sub-ppb TCE detection limits in an approximate analysis timeframe of 15 minutes required for some VI applications, a high volume sampling tube packed with 100 mg of Carboxen 100 is added to the front end (prior to the μ PCF). In addition, a pre-trap is being tested to preclude semi-volatiles from entering the system. On the basis of calibrations performed from 2-20 ppb of TCE in air, the calculated TCE detection limit is 0.06 ppb_v (20-L sample). TCE could be separated from 9 common co-contaminants in < 2 minutes. Two μ GC prototype configurations are being developed. The portable μ GC unit is designed for analyzing multiple samples at different locations throughout a home during a single site visit to evaluate potential sources of TCE in a forensic, site assessment-type mode; this unit can be used to assess potential indoor sources of TCE. The fixed μ GC unit is designed long-term operation (weeks, months) with wireless communications in a single location with multiple samples throughout each day for exposure and/or mitigation system performance assessments. A field demonstration of both μ GC prototypes is planned for the summer of 2010 in the vicinity of Hill AFB, UT. The field demonstration will evaluate the practical use of the μ GC for TCE determinations in various VI applications. The μ GC can also be adapted to the analysis of other VOCs of VI concern.