Rapid Determination of Environmental Tobacco Smoke Markers at Part-Per-Trillion Levels

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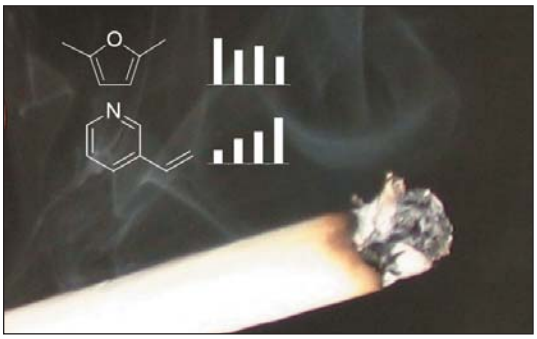

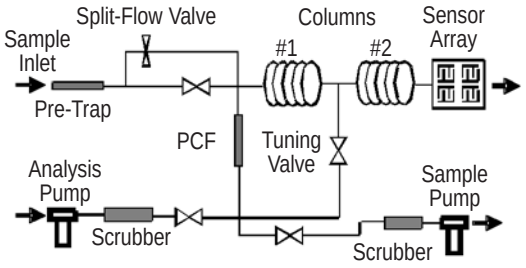

Environmental tobacco smoke (ETS) is a complex mixture of compounds collectively classified by the International Agency for Research on Cancer as carcinogenic. The complexity of ETS and the presence of confounding sources in many environments have impeded accurate exposure assessments and have led to efforts to find surrogate measures of ETS contamination levels. Two such markers are 3-ethenylpyridine (3-EP) and 2,5-dimethylfuran (2,5-DMF). In a study completed this year, selective preconcentration, dual-column separation, and sensor-array detection were combined in a meso-scale gas chromatograph for the determination of these two markers in a complex matrix of indoor air pollutants. Conditions were established to quantitatively capture the markers, separate them from the 34 most prominent co-contaminants found in real-world samples (from a bowling alley), and detect them using response patterns from a chemiresistor array coated with gold-thiolate nanoparticles, using ambient air as the carrier gas. A complete analysis can be performed every 15 minutes. Projected detection limits are 580 and 80 parts-per-trillion for 2,5-DMF and 3-EP, respectively, for a 1-liter sample volume, which are sufficiently low to determine these markers in typical smoking-permitted environments. This project entailed collaborations among three departments across the University of Michigan campus (Environmental Health Sciences, Chemistry, and Electrical Engineering and Computer Science), as well as a small manufacturer of gas monitoring instrumentation. Results are being used to guide the application of the WIMS μGC, which shares several design features and the same detector technology, to similar environmental monitoring problems. ■