A Wearable Wireless System for Real-Time Monitoring of Chemical Toxicants

NJ Tao[1], Erica Forzani[1], Ray Tsui[2], Jonathan Lewis[2], Melisa Drate[3], Jay Gandofi[4]

Arizona State University[1], *Motorola Labs*[2], *Arizona Department of Occupational Safety & Health*[3], *University of Arizona*[4]

The ability to quickly and reliably detect chemical toxicants in air is critically important for health risk assessment, for better understanding the role of gene-environment interactions in human diseases, and for health disparities research. Current detection of chemical toxicants relies on bulky and expensive spectroscopic and chromatographic techniques that require considerable maintenance and operator expertise, which are not practical for continuously monitoring various chemicals at multiple locations. Many portable devices have been proposed and developed, but they have different limitations ranging from low selectivity, insufficient sensitivity, limited scope and high costs. The present project brings together a joint effort involving chemical sensor researchers at Arizona State University, a toxicologist at University of Arizona, R&D scientists and engineers at Motorola, and field testing experts at Arizona Division of Occupational Safety & Health to build, validate and test a powerful wearable sensing system. The sensor technology is built upon a novel microfabricated tuning fork array sensor platform invented at ASU and wireless sensor technology developed at Motorola (Figure). The project leverages on the expertise and resources gathered for an on-going collaborative R&D effort on wireless chemical sensors between the ASU and Motorola team. The goal is not only a wearable sensor system for quick, accurate, and reliable detection of chemical toxicants, but also an affordable, easy-to-upgrade and user friendly product for population studies.

Unique features of our system include:

- A novel tuning fork array sensor platform developed by the PIs offers high sensitivity, tunable specificity, good thermal and mechanical stability, fast response, and low cost & power consumption.
- A wireless sensor technology developed at Motorola provides seamless integration of sensors and communications for real-time sensor control, data collection, processing, and transmission.
- Modular design allows users to easily upgrade each component (wearable device, communication module and cell phone), and flexibly select different sensor cartridges for different tasks, or replace older cartridges with the newest ones. The flexibility and upgradeability are necessary for a successful product because both wireless and sensor technologies are advancing rapidly.

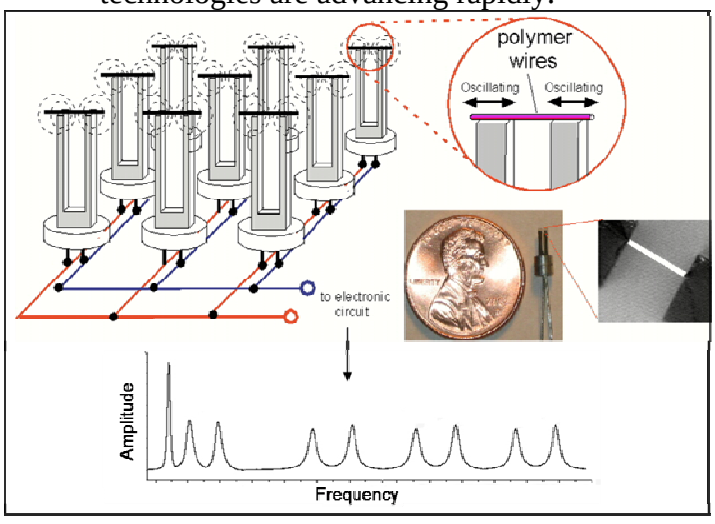

Figure. A tuning fork sensor array. Each sensing element consists of a polymer wire stretched across the two prongs of a quartz tuning fork. An electronic circuit drives all the sensing elements in the array into resonance and detects the resonance at the same time. Lower right corner images show the scale of a typical sensing element.