Wearable Nanosensor Array for Real-Time Monitoring of Diesel and Gasoline Exhaust Exposure

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Diesel and gasoline exhaust, produced when an engine burns fuel, is a complex mixture of gases and fine particles (commonly known as soot). It contains over 40 toxic air contaminants**,** including nitrous oxide, nitrogen dioxide, hydrogen disulfide, sulfur dioxide, carbon monoxide, carbon dioxide, formaldehyde, benzene, toluene, naphthalene, polyaromatic hydrocarbons, nitro-polyaromatic hydrocarbons, acrolein, arsenic and 1,3-butadiene. Recent studies have linked respiratory diseases and cancer to exposure to gasoline and diesel exhaust. These diseases, however, are also attributed to genetic susceptibility. Establishing a direct linkage of these diseases to diesel and/or gasoline exhaust requires reliable and reproducible quantitative measure of exposure.

The overall aim of the proposed collaborative research is to create, evaluate and validate an autonomous/self-contained wearable, approximately 4" by 4", sensor array for the real-time monitoring of exposure through inhalation to the gaseous components of internal combustion engine exhaust. The fully integrated light-weight sensor that can be worn as a badge similar to a γ-radiation counter will comprise of arrays of conductometric and amperometric sensors, and low-power fully-integrated microelectronics for power management, data collection, and signal processing, as well as wireless communications. Arrays of independent sensors can offer much more analytical information on personal exposure and thus hold a great potential for selective and accurate monitoring of low concentrations of mobile source air toxics and other relevant pollutants in real-time. The conductometric and amperometric platforms have strengths that are complementary to each other and are extremely IC compatible. Advanced data processing will be used for generating distinct response patterns and detecting the individual agents in vapor mixtures. Such judicious integration of two powerful detection schemes along with an intelligent data processing should dramatically increase the gathered information on personal exposure to offer remarkable reliability along with broad scope, while meeting the portability requirements of decentralized detection systems. Our multidisciplinary expertise, extensive preliminary data and past successful collaboration lay the groundwork for the proposed activity.