INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Microfabricated Passive Vapor Preconcentrator/Injector Designed for Microscale Gas Chromatography

TECHNOLOGY NUMBER: 5162

Technology ID
5162

Category
Hardware
Engineering & Physical Sciences
Semiconductors, MEMS, and Electronics

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OVERVIEW

Efficient VOC sampler-injector for micro gas chromatography (μGC) systems

- Reduces power consumption and enhances rapid desorption efficiency
- Environmental monitoring, industrial emission testing, and indoor air quality assessment

BACKGROUND

Volatile organic compounds (VOCs) are significant pollutants with potential health impacts, necessitating efficient detection methods in environmental monitoring. Historically, detecting VOCs involves gas chromatography systems that require preconcentration to identify low-level concentrations. Traditional methods deploy pumps to draw air samples through adsorbent materials, significantly increasing power consumption and limiting their operational efficiency. These pumps are essential for long-term sampling of environmental VOCs at parts-per-billion (ppb) levels. Despite advancements, traditional systems struggle with power efficiency, speed, and the integration of sampling and desorption processes. Hence, there is a pressing need for a cost-effective, power-efficient microfabricated solution capable of spontaneous VOC sampling and rapid desorption, making environmental monitoring more accessible and reliable.

INNOVATION

The innovation lies in the creation of a microfabricated integrated sampler-injector (MISI) for micro gas chromatography (μGC) systems. This device operates on spontaneous sample diffusion, eliminating the need for power-consuming pumps. The MISI features a silicon cavity with an integrated heater and temperature sensor, packed with a carbon adsorbent, enabling VOC preconcentration and rapid thermal desorption. The device can heat from room temperature to 250°C in 230 milliseconds using only 1 watt of power. This design allows precise sampling rates by passive diffusion and ensures sharp injection pulses for high-speed chromatographic separations. Real-world applications include environmental monitoring, industrial emission testing, and indoor air quality assessment, offering a compact, efficient, and power-saving solution compared to existing technologies.

ADDITIONAL INFORMATION

J. H. Seo, S. K. Kim, E. T. Zellers and K. Kurabayashi, "Microfabricated integrated sampler-injector (MISI) for micro gas chromatography," 2011 IEEE 24th International Conference on Micro Electro Mechanical Systems, Cancun, Mexico, 2011, pp. 825-828, doi: 10.1109/MEMSYS.2011.5734552

US9316623 "Micro-scale passive vapor preconcentrator/injector"