What is Thermal Conductivity Detector (TCD)?

A TCD obtains information about composition of surrounding gas medium by thermo-physical analysis of the gas.

Resistance of a suspended doped polysilicon structure is a function of temperature; if heated, its temperature depends on thermal conductivity and thermal capacity of the gas.

Motivations for microTCD

Conventional gas detectors suffer
- large power consumption
- slow time response
- Frequent re-calibration requirement
- Memory effects and frequent replacement

microTCD gas sensors offer
- Much lower power consumption
- Faster time response
- Enhanced sensitivity
- Lower cost

Applications of the present work

- Detection of Helium leaks in space station
- Detection of natural gas leak and detection of methane in mining
- Air quality monitoring.
- Combustion process monitoring and optimization
- Gas chromatography (GC) systems
- Health: breath analysis detection of NO, CO₂, O₂

Micro-Fabrication Process

1. Thermally grown SiO₂, 10 µm
2. Silicon Nitride Layer LPCVD, 0.4 µm
3. Polysilicon layer LPCVD, 1µm
4. P-type doping of Polysilicon
5. Silicon Nitride LPCVD, 0.2 µm
6. RIE for electrical contacts
7. Pt and Au evaporations for contacts
8. RIE of nitride to form a mask for SiO2 etching
9. BOE etching of SiO2, beam suspension

Experimental Results, Sensor Response

Ultra-fast transient response

Sensor Lifetime Test

Linear response to gas composition

Conclusions

- The sensor is extremely stable, lifetime exceeds 34 billion measurements.
- Ultra-fast response in less than 1 ms.
- No memory effect
- Low power consumption, of 50 microWatt
- Detection levels of few hundred ppm for methane and CO₂

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Reference