

# Squeeze-film pressure sensor

## Sensor for measuring two properties of a gas

Reference no. P 173

### BACKGROUND

Pressure sensors are used in various technical sectors, such as in cryogenic or ultra-high vacuum environments, in chip manufacture, and in vehicle hydrogen storage tank monitoring. The gas temperature and gas pressure must be kept within certain limits in conventional methods. For very low gas pressures, such as in ultra-high vacuums or in the case of cryogenic gases, it is only possible to measure the gas pressure indirectly. Commercially available pressure measuring devices output a total pressure value for a gas or gas mixture. However, information about the type of gas or, in the case of a gas mixture, the partial pressures cannot be gathered with existing pressure measuring devices.

### SOLUTION

This novel pressure sensor is a vibrating nanomechanical membrane under high tensile stress. It is a so-called trampoline membrane and is micrometers apart from a parallel surface, which produces a squeeze film in the resulting intermediate space (see Image 1). There is also simultaneous measurement of the quality factor and the resonance frequency of the gas pressure with known analytical relations to the pressure of the gas and the mass of its particles.

### ADVANTAGES

- Compact sensor with variable positioning, making local pressure measurement possible
  - Suitable for wide temperature ranges (-269°C to > 300°C), pressure ranges from UHV to > 1013 mbar (more than 10 orders of magnitude) with a single sensor
  - No calibration required (based on "first principles")
- Compatible with strong magnetic fields thanks to optical readouts and use of non-magnetic materials. Electronic readout

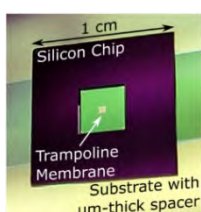


Fig. 1: Silicon chip with free-standing trampoline membrane on a glass substrate with  $\mu\text{m}$ -thick spacer layer (image: Hossein Masalehdan)

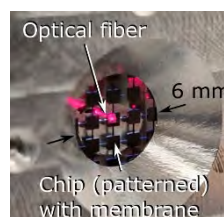


Fig. 2: Membrane-based pressure sensor with compact fiber-optic readout (image: Hossein Masalehdan)

### FIELDS OF APPLICATION

Monitoring for:

- Hydrogen tanks in vehicles
- Leakage detection in SLH 2 or CcH 2 storage tanks
- Precise UHV measurements
- Measurements over wide pressure ranges (from UHV to overpressure) with a single sensor
- Local pressure measurement
- Pressure measurement in strong magnetic fields

### PROPERTY RIGHTS

EP 23 167 602.4

### POSSIBILITIES FOR COLLABORATION

- Licensing
- R&D cooperation

### CONTACT

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