VTT Information Technology - Microsensing

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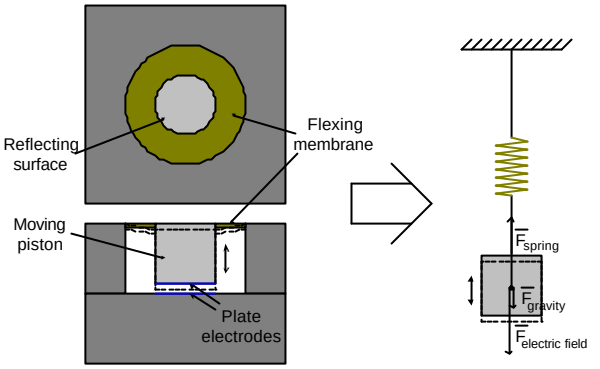
Micro-Electromechanical Mirror for Fourier Transform Interferometry

Miniaturised interferometers based on accurately controlled moving micro-electromechanical mirrors have been selected as one of the focus areas at VTT Information Technology. This technology enables new kinds of interferometer designs to be used in space instruments.

Fourier Transform Spectrometers (FTS) are used in composition analysis of various materials. Current devices are large and they fit poorly for on-line process measurements. Their large size is also a disadvantage in space applications. The motivation for the development of a small, precisely moving mirror has been to solve these problems with novel miniaturised interferometers.

Based on a VTT study, a mathematical model for a micro-electromechanical (MEMS) moving mirror was developed and a structure for the component was constructed. The structure was based on a VTT-patent for a micromechanical silicon precision scale.

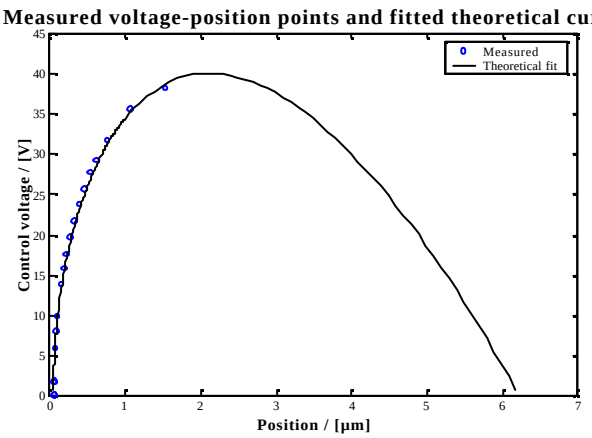
Tests performed with a proto sample demonstrated that the mirror theory applied well and therefore its development towards a real spectrometer has a realistic foundation.



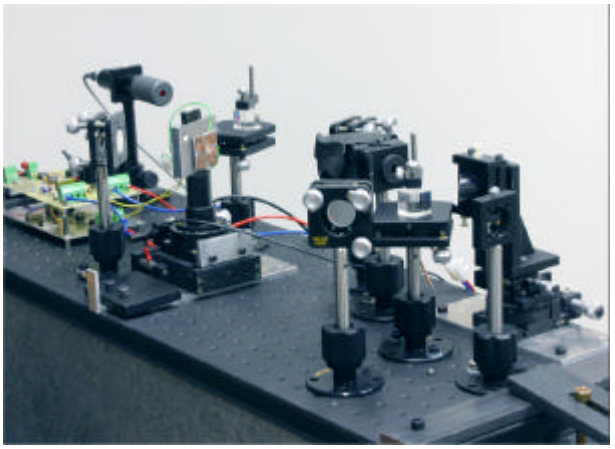
Schematic top and side view of the mirror (not to scale) and the physical model used

Current Design Technical Info

- Mirror chip size: 11 x 11 x 0.8 mm^3
- Reflector diameter: 6 mm
- Maximum travel distance (current design): 30 µm
  - The maximum distance for the prototype was ca. 6 µm.
  - Next generation can have a travel range of at least 60 µm.
- Maximum control frequency: ~1 kHz
- Theoretical position accuracy: < 0.01 nm
- Theoretical angular accuracy: < $10 \cdot 10^{-5}$ arc sec
- Measured prototype repeatability: < 0.7 nm



Measurement results from prototype measurements



Test setup for the characterisation of the MEMS component