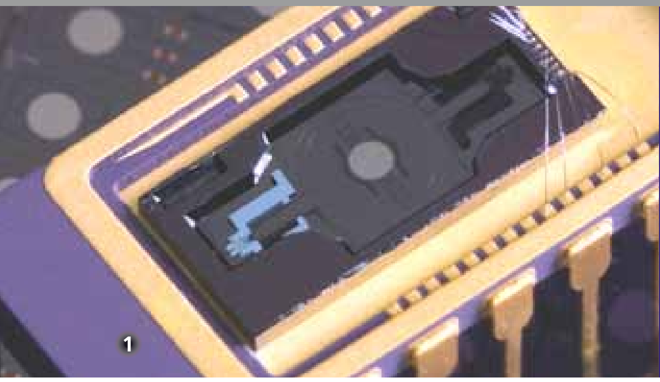
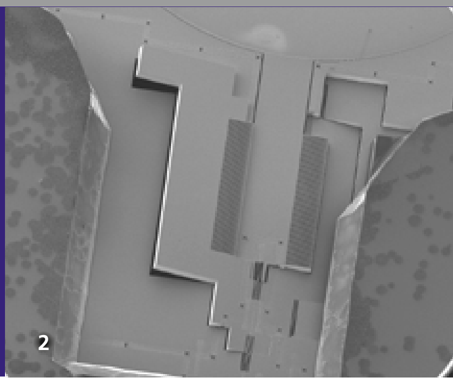
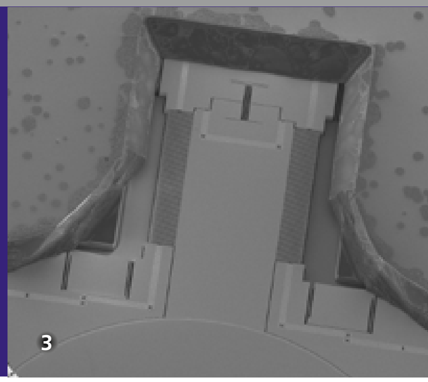
FRAUNHOFER INSTITUTE FOR PHOTONIC MICROSYSTEMS IPMS







1 *2D LinScan microscanner demonstrator in DIL20 ceramics housing.*
2 *Staggered vertical comb (SVC).*
3 *Centered vertical comb (CAVC).*

LinScan Microscanners

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Introduction

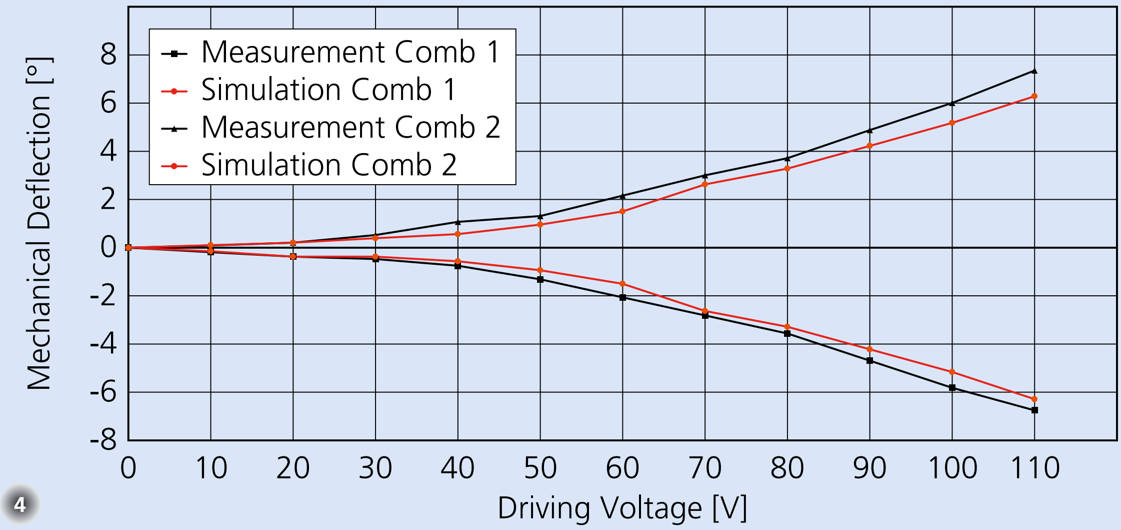
A broad variety of potential microscanner applications demand dynamic light deflection in conjunction with meeting specific constraints regarding the scan trajectory.

For example scanning light with constant velocity over a projection plane or adapting the scan speed dynamically can be of importance. Both use cases can not be utilized with resonant scanning microscanners.

Based on a long and successful track record in research and development of electrostatic resonant MEMS scanners Fraunhofer IPMS now features LinScan, a new device concept for quasistatic operating microscanners. LinScan is based on the AME75 process that was developed and qualified for electrostatic resonant operating MEMS scanners and enables building quasistatic 1D microscanners and monolithic hybrid quasistatic resonant 2D microscanners. Fraunhofer IPMS offers customer specific conception and development of LinScan devices in form of research and development projects.

Function

With LinScan devices the mirror is operated quasistatically on one axis via so-called vertical comb drives. The vertical comb drives are application specifically optimized as angular (AVC), centered angular (CAVC) or staggered (SVC) vertical comb drives. If it is a 2D device the gimbal mounted second axis is resonantly driven by planar comb drives.



Technology

LinScan devices are build from a BSOI substrate by a bulk micro-machining process (AME75). All mechanical device structures are made of monocrystalline silicon by DRIE etching of the device-layer. The vertical comb drives are realized at the end of the fabrication process with help of adhesive wafer-to-wafer bonding. A silicon wafer with openings and stamps is aligned to the mirror wafer; the wafers are pressed together and bonded. While the wafers are pressed together, stamps press on areas designed to activate solid-body mechanisms. These mechanisms provide support to the comb electrodes attached and translate and fix them into a position outside the device layer. The simple and secure 3D fabrication process allows for great design variability and very good electrode aligning.

The LinScan device concept is suitable to fit a great variety of customer requirements.

Example of device characteristics

- Mirror diameter: 1.2 mm
- Aluminum mirror coating
- Reflectance:
  88% to 92% within visible range
- Static mirror planarity:
  mirror curvature > 5 m
- Dynamic mirror planarity:
  typically better $\lambda/20$

Quasistatic drive characteristics:

- Scan frequency: 0 - 0.145 kHz
- Maximum static deflection
  ±7.5° @ 110 V

Resonant drive characteristics:

- Scan frequency: 23.5 kHz
- Nominal amplitude: ±9.5° @ 160 V

The above characteristics are design-specific and do not represent design limitations. Device characteristics can vary significantly according to customer requirements.

Applications

- Laser projection/display
- Optical vibration compensation, e.g. hand-held laser craniotome
- Linear scanning
- Beam positioning/trajectory tracking
- Material processing/laser writing

4 *Quasistatic mirror deflection via drive voltage*