PRESS RELEASE

Micromachine/MEMS 2010
from 28th of July to the 30th of July 2010 in Tokyo/Japan
hall 5&6, booth G-38

Fraunhofer IPMS, Dresden carries out customer specific developments in fields of microelectronic and micro systems technology serving as a business partner who supports the transition of innovative ideas into new products. Fraunhofer IPMS develops and fabricates modern MEMS and OLED devices in its own clean room facilities. In addition to R&D services it offers ramp-up within a pilot production. With modern equipment and about 200 scientists and engineers, the range of projects and expertise covers sensor and actuator systems, micro scanner, spatial light modulators, lifetronics as well as organic materials and systems.

At the Micormachine/MEMS 2010 in Tokyo Fraunhofer IPMS presents:

1. MEMS Micro Mirror Array Demonstrator

MEMS based light modulators (Spatial Light Modulators, SLMs) are utilized for spatial and temporal modulation of light. They consist of high speed controllable micro mirrors, which can be addressed and deflected independently. This allows the modulation of light intensity and phase on individual pixel scale. The micro mirrors can be arranged in various geometrical configurations. The pixel number can vary from low resolution up to several million mirrors. If high resolution is required, the necessary multiplexing of data is performed by on-chip CMOS electronics. The MEMS of the Fraunhofer IPMS can be adapted for light wavelengths from 193 nm up to 1500 nm according to application specific needs. In contrast to digital micro mirrors typically applied in projection systems the SLMs developed by the Fraunhofer IPMS can display gray values in real-time, i.e. without pulse width modulation. Application fields for SLMs are pattern projection, adaptive optics, Computer To Plate (CTP), PCB manufacturing, wafer level packaging, mask writing, material processing and marking, copyright protection and holography. The setup demonstrates the functionality of the SLM utilizing a LED illumination. Programmed spatial micro mirror pattern can be observed by naked eye.

2. LDC (Light Deflection Cube) – a 1D scanner module

Based on its competence in developing and fabrication of micro scanner devices Fraunhofer IPMS presents a 1D micro scanner module. Its modular platform approach was developed to bridge the gap between the supply of bare micro scanner dies and the final integration in the customer application. With the drastic enhancement of the short term availability of OEM-capable customized solutions the institute proofs its competence for MOEMS specific packaging, electronics development and system design. The application specific scanner system is based on a modular approach where several prefabricated components are chosen to meet our customers' demands.

The complete modular platform LDC consists of:

- A micro scanner device (selected from available devices or even customized fabricated at Fraunhofer IPMS),
- Chip carrier with housing and front optics,
- Scan head with miniaturized optoelectronic position sensor for deflection control,
- Electronics for driving the micro scanner with a standard communication interface (SPI) and I/O ports and GUI software.

A selected 1D module based on the above-described LDC platform is exhibited at Micromachine/MEMS 2010. This LDC module comprises a 1D micro scanner device with 23 kHz resonance frequency mounted on a PCB substrate housed by a glass dome as optical interface, an optical position sensor as well as the miniaturized driving electronics. A modular LDC platform for 2D micro scanners is currently under development and will be available, soon.

3. MEMS based Adaptive Optics

Adaptive Optics (AO) is used for the control of the optical wave front of light, e.g. the compensation of spatially and timely varying wave front disturbances, which may arise from inhomogeneous or turbulent media within the optical path, in order to facilitate or enhance optical imaging through such media. Originally evolved from astronomy to compensate for atmospheric turbulences, AO techniques can also be used in ophthalmology for aberration correction of the human eye, in optical microscopy for imaging through biological tissue or for any kind of object recognition in machine vision. Furthermore, there are applications in laser beam shaping and in ultra-fast laser pulse modulation as well.

The key component is formed by the actual wave front controlling device. For that purpose MEMS (Micro Electro Mechanical System) based micro mirror arrays offer several attractive features. The on-chip integration with addressing electronics supports large pixel numbers providing an exceptionally high spatial resolution for an improved reproduction especially of higher order phase aberrations. They also benefit from a step function display capability, fast mechanical response times, low power consumption, broad spectral bandwidth from IR down to DUV and polarization insensitivity. Compared to previous macro scale systems micro mirrors also offer the potential of a substantial cost decrease as well as a significant device miniaturization just facilitating completely new possibilities for a broader commercial exploitation.

The Fraunhofer IPMS has developed a complete MEMS Phase Former Tool Kit. The key component is a high-resolution 240 x 200 piston micro mirror array with 40 µm pixel pitch. The micro mirror stroke can be tuned to >1 µm at 8 bit resolution corresponding to >2 µm phase shift in reflection. Full user programmability and control is established by a comfortable driver software for Windows XP® PCs supporting both a Graphical User Interface as well as an open ActiveX® programming interface for open-loop and closed-loop operation. High-speed data communication is accomplished by an IEEE1394a FireWire interface together with an electronic driving board allowing for maximum data transfer rates of up to 500 Hz. The mirror array itself is capable of operating at maximum frame rates of 5 kHz.

In order to visualize the potential for optical imaging enhancement a complete AO demonstrator system has been set up. It basically consists of a projection system, where extended objects can be imaged through adaptive optics onto a CCD camera. Phasefront errors of different severeness can be introduced by rotating phase plates. Employing a Shack-Hartmann sensor for detection and the Fraunhofer IPMS MEMS micro mirror array for correction of the wave front, the obtainable imaging improvement is visualized by means of the recorded CCD image displayed on a video screen. For a more quantitative performance characterization also MTF measurements can be carried out with the setup.

Addressed business fields are optical system developer and manufacturer in the following areas:

- Machine Vision (in-situ process control through turbulent media)
- Optical Microscopy
- Ophthalmology
- Astronomy
- Laser Pulse Shaping
- Laser Beam Shaping
- Diffractive Optics (especially optical tweezers)

4. LAMDA – Large aperture MEMS scanner module for 3D distance measurement

Traditional laser scanners for 3D distance measurement involve expensive, heavy and large rotating or vibrating mirrors as a means for light deflection. Typically, the precision of TOF (Time of Flight) or laser phase shift distance measurements is limited by the amount of optical signal available at the detector. Hence, a scanning mirror with large aperture is required for LIDAR systems to collect the reflected or scattered light from the target.

LAMDA is a segmented, scalable 1D-MEMS scanner comprising several scanning mirror elements with an aperture of 2.5 x 9.5 mm², each. The system allows for a large total optical scan range of 60°. The module provides two separated scanning channels: (1) a single scanning mirror for the collimated beam to scan the scene. (2) A segmented scanning mirror for the receiver optics. (1) and (2) are synchronized with respect to phase and amplitude. The optical path for the collimated scan beam and the receiver optics are isolated. Consequently, any optical crosstalk is avoided in the final LIDAR system.

The segmented scanning mirror consists of 2 x 7 identical mirrors with a total aperture of 334 mm² and an optical fill factor of 80 %. The mirrors are driven resonant by means of electrostatic forces using an in-plane comb-drive. Resonance frequency is 250 Hz. As master the scanning mirror for the collimated scan beam is used. Each of the 2 x 7 identical mirrors of the receiver optics is synchronized to the master by the control circuitry. For that each mirror is equipped with a miniaturized position sensor.

The aperture size of the individual mirrors add up to a total aperture which provides a large enough optical signal at the detector for most applications. LAMDAs' electronic circuitry measures 50 x 40 x 40 mm³, only. It provides a synchronic position signal of the current scan angle for the signal processing within the 3D LIDAR system. With an operation frequency of 250 Hz LAMDA fulfills highest requirements of modern TOF and laser phase shift distance measurement systems with a point rate output of 250-1000 kHz. This translates into 500 – 2000 intervals within the optical scan range.

The novel concept of a segmented MEMS scanner consisting of identical and synchronized oscillating MEMS mirrors allows us to offer systems with the following advantages: large receiver optics with outstanding optical properties even for scan frequencies well in the kHz-range, compact size, low weight and high reliability.

5. MEMFIS – an out of plane translatory MEMS actuator with large stroke for optical path length modulation

Fourier Transform Infrared (FT-IR) spectroscopy is a widely used method to analyze different materials - organic and inorganic. Current FT-IR spectrometers are large, usually not portable, and often require operation by specially qualified personnel. By using translational MOEMS devices for optical path length modulation instead of conventional highly shock sensitive mirror drives a new class of miniaturized, robust, high speed and cost efficient FTIR-systems is enabled.

At Micormachine/MEMS Fraunhofer IPMS presents for the first time a translatory MOEMS actuator with extraordinary large stroke– especially developed for fast optical path length modulation in miniaturized FTIR-spectrometers. A precise translational out-of-plane oscillation at 500 Hz with large stroke of up to 1 mm and large mirror aperture of 19.6 mm² is realized by means of a new MEMS design. The novel translatory MOEMS actuator was specially designed to enable a miniaturized MEMS based FTIR spectrometer with improved system performance of 5 cm^{-1} spectral resolution (λ=2.5…16 µm), SNR > 1000 and fast operation of ≥500 scans/s.

The new translatory MEMS actuator comprises four symmetric pantographs to suspend the mirror plate. As a result extraordinary large strokes of up to +/- 1 mm are achieved for the 5 mm diameter mirror. This enables a completely new family of low cost handheld FTIR analyzers e.g. for on-site inspection of food or environmental parameters. We acknowledge financial support by the European Commission in the context of the FP7 project MEMFIS.

6. MEMS Technologies Dresden

The Fraunhofer Institute for Photonic Microsystems features everything needed for the development, fabrication and integration of technologies for micro-electro-mechanical systems (MEMS) and micro-opto-electro-mechanical systems (MOEMS): outstanding technology know-how, expertise in industrial manufacturing projects and the infrastructure needed including state-of-the-art equipment and 1.500 m^2 class 10 clean room facilities. Using this potential at the Micromachine/MEMS 2010 show the institute wants to especially support Asian companies by applying innovative MEMS technologies.

Nowadays MEMS devices with diverse features can be found in a wide range of products such as printing machines, automotive vehicles, mobile phones or consumer electronics. They are used as sensors for process management and quality equipment as well as for telecommunication or medical technology. Our business model allows companies without the needed equipment or facilities to develop and sell highly specialized products, as well. The institute covers the whole value chain from technology and product development to pilot-fabrication including feasibility studies, simulations of critical parameters and process flows, design, single process development and prototyping to mid size volume production.

In order to learn more about these new opportunities for MEMS development and fabrication the Fraunhofer IPMS invites all Micromachine/MEMS visitors to visit the exhibition booth as part of the IVAM exhibition area and to attend the presentation „MEMS Technologies Dresden: development and fabrication" within the 3. Japanese-German Micro/Nano Business Forum.

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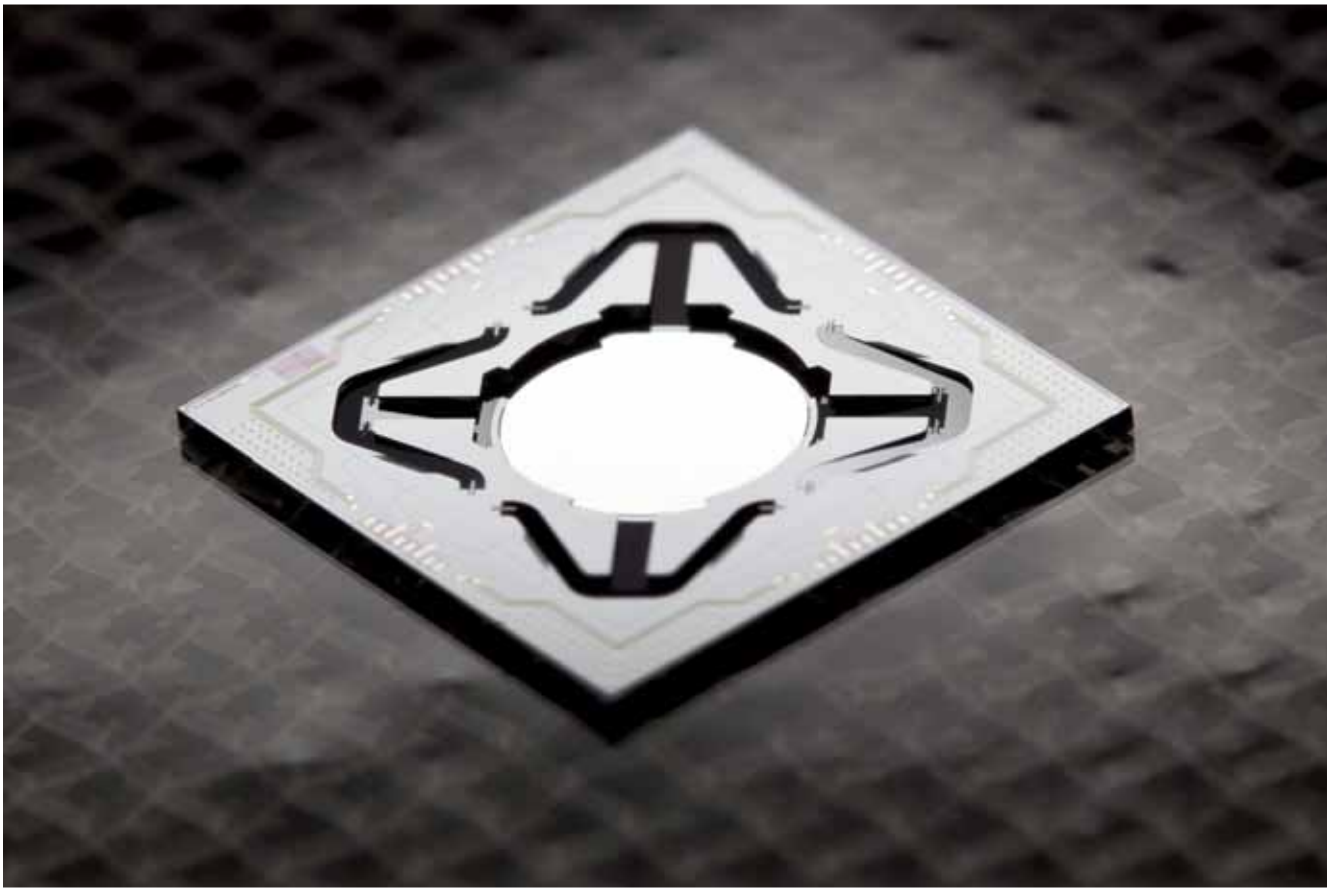

MEMFIS a new translatory MOEMS actuator