PROCEEDINGS

53. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

Faculty of
Mechanical Engineering

PROSPECTS IN MECHANICAL ENGINEERING

8 - 12 September 2008

www.tu-ilmenau.de

TECHNISCHE UNIVERSITÄT
ILMENAU

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

Published by
Impressum

Publisher Herausgeber	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Dr. h. c. Prof. h. c. Peter Scharff
Editor Redaktion	Referat Marketing und Studentische Angelegenheiten Andrea Schneider Fakultät für Maschinenbau Univ.-Prof. Dr.-Ing. habil. Peter Kurz, Univ.-Prof. Dr.-Ing. habil. Rainer Grünwald, Univ.-Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. mult. Gerd Jäger, Dr.-Ing Beate Schlütter, Dipl.-Ing. Silke Stauche
Editorial Deadline Redaktionsschluss	17. August 2008
Publishing House Verlag	Verlag ISLE, Betriebsstätte des ISLE e.V. Werner-von-Siemens-Str. 16, 98693 Ilmenau

CD-ROM-Version:

Implementation Realisierung	Technische Universität Ilmenau Christian Weigel, Helge Drumm
Production Herstellung	CDA Datenträger Albrechts GmbH, 98529 Suhl/Albrechts

ISBN: 978-3-938843-40-6 (CD-ROM-Version)

Online-Version:

Implementation Realisierung	Universitätsbibliothek Ilmenau ilmedia Postfach 10 05 65 98684 Ilmenau

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

53rd Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
08 – 12 September 2008

Wilfried Noell / Nico de Rooij

MEMS-Based Photonics

Abstract

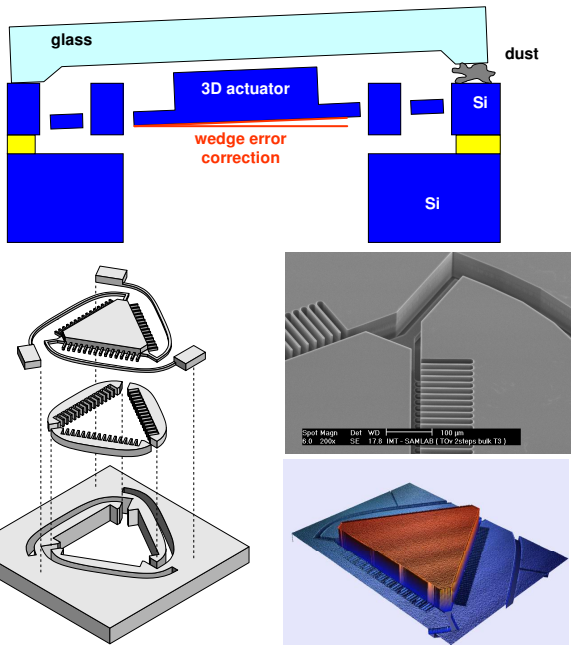
Silicon-based photonic MEMS (Micro-ElectroMechanical Systems) modulate light by displacing microoptical elements such as micromirrors, microlenses, and large arrays of such elements. Applications are in astronomy, display, and telecommunication.

1. Introduction and Devices

Small photonics systems require accurately displaceable micro-optical elements such as micromirrors, microlenses and gratings. Typical applications and systems are tunable cavities (interferometers, lasers, filters, etc), beam manipulating devices, e.g. scanners and deformable mirrors for adaptive optics, fiber-laser couplers, and spectrometers. In these configurations MEMS devices are often used as suitable solutions. Recent developments have shown that MOEMS-based devices can provide a high level of optical flatness at rest and dynamic positioning. The conference talk will show several applications and devices. In this abstract we show two basic devices as demonstrators.

A. Tip-tilt Micromirror

In tunable optical cavities, the tunable element can be a micromirror. The mirror needs to be extremely flat and to be displaced very precisely. We have designed and fabricated a compact accurately controlled piston tip-tilt micromirror, which shows extreme optical flatness and large tunability of almost 20µm mechanical stroke. The inner circle of the triangular micromirror has a diameter of 1mm. The platform is

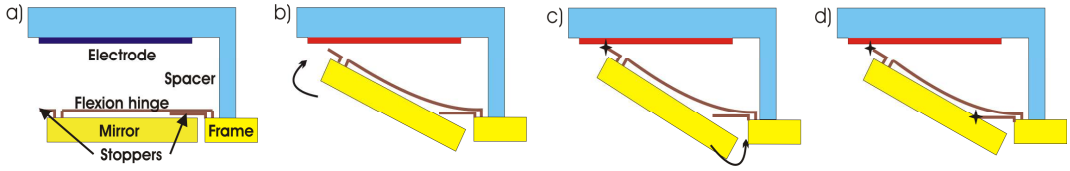


actuated by asymmetric vertical comb-drive actuators. The actuation voltage is about 50V. There are three actuators integrated in the platform, one on each side of the triangle. Thus a full 3D movement can be created for very small tilt variations, which are essential for compensating tilting errors in optical cavity systems [1].

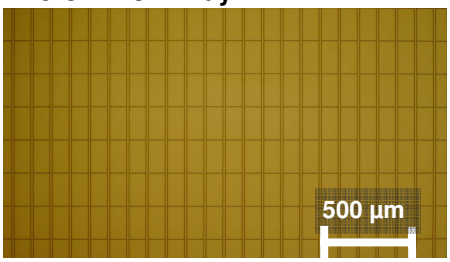
B. High Fill-Factor Micromirror Array

Multi-object spectrographs (MOS) help increasing the scientific efficiency of astronomical observations by recording simultaneously the spectra of hundreds of objects. They require a programmable slit mask in the focal plane of the telescopes for the object selection. We present a MEMS-based approach that utilizes a micromirror array as a reflective slit mask for next generation MOS, which was developed in collaboration with the LAM in Marseille. The objects are selected by tilting the micromirrors, which send the incoming light towards the spectrograph. The micromirrors are very flat, measure 100x200µm^2 and provide a mechanical tilt of 20°. The array has a very large fill factor of over 90%. The micromirrors and their package were tested mechanically and optically at a temperature of 92K, which is necessary for mid-infrared applications, and showed no degradation in this cryogenic environment [2].

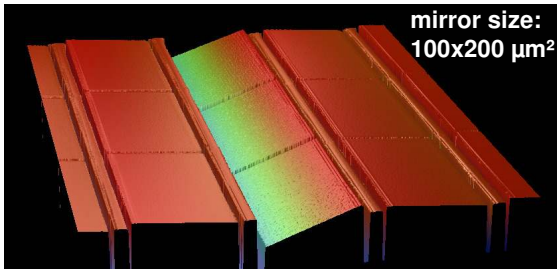
MEMS micromirror with lock-in-place configuration for stable tilt angles



Micromirror Array



Tilted Mirrors → Reflective "Slit" Mask



References:

[1] *Compact and stress-released piston tip-tilt mirror*, W. Noell, T. Overstolz, R. Stanley, and N. F. de Rooij, Proc. SPIE 6186, 61860H (2006), DOI:10.1117/12.666511.

[2] *Uniform tilt-angle micromirror array for multiobject spectroscopy*, Severin Waldis, Frederic Zamkotsian, Pierre-Andre Clerc, Wilfried Noell, Michael Zickar, Patrick Lanzoni, and Nico de Rooij, J. Micro/Nanolith. MEMS MOEMS 7, 021014 (2008), DOI:10.1117/1.2920338.

Authors:

W. Noell, S. Waldis, and N. de Rooij of IMT/Neuchâtel. T. Overstolz of CSEM, Neuchatel.
Institute of Microtechnology (IMT), University of Neuchâtel, CH-2000 Neuchâtel, Switzerland
Phone: +41-32-720.5548, fax: +41-32-720.5711, E-mail: wilfried.noell@unine.ch