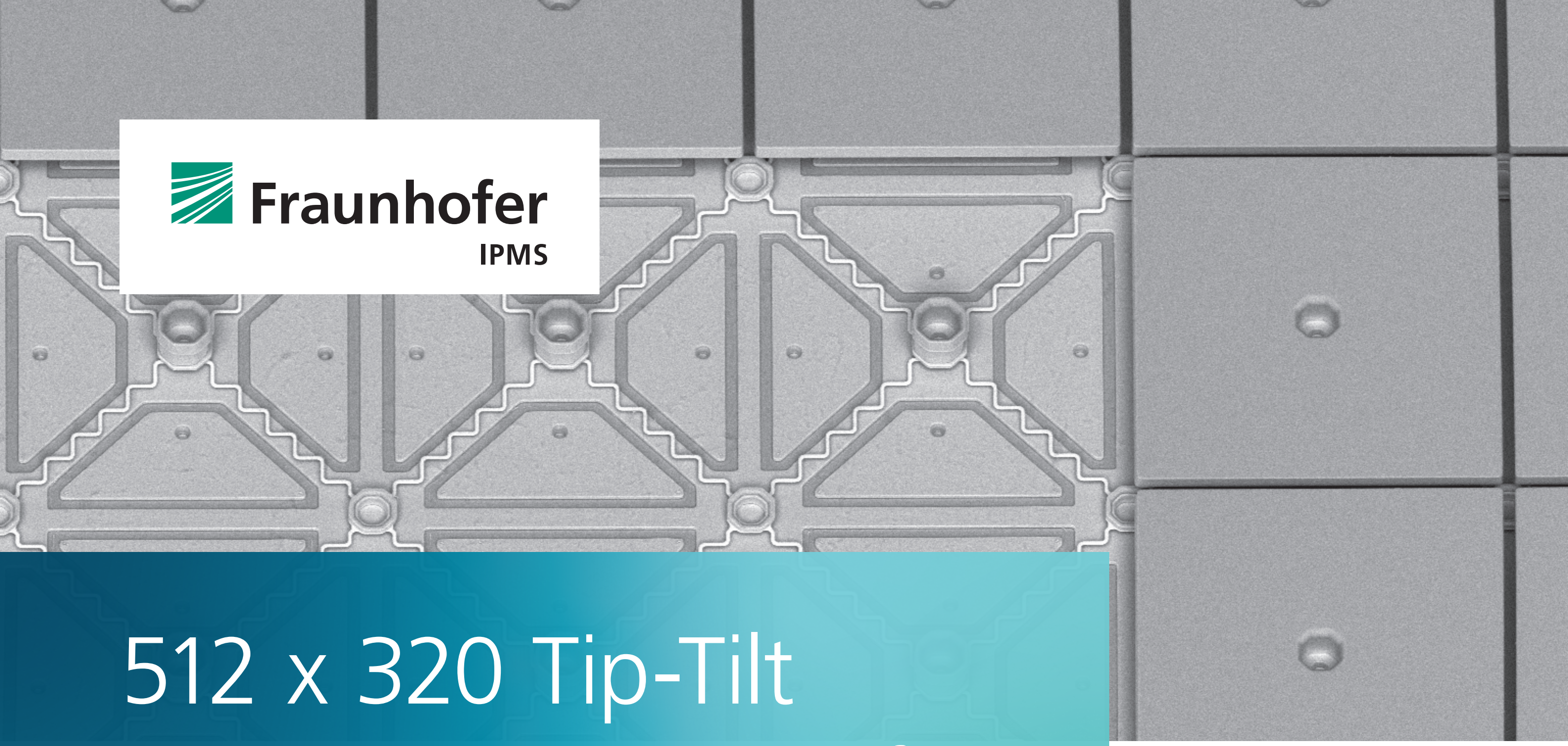


SEM photograph of single pixels
(mirrors partly removed)

512 x 320 Tip-Tilt Micro Mirror Array for Optical Beam Steering

The Device

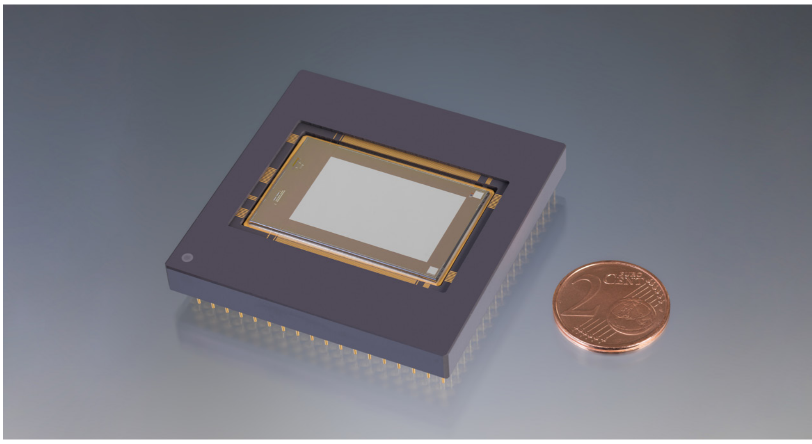
The Fraunhofer IPMS has developed a novel Tip-Tilt Micro Mirror Array (MMA) for applications in optical beam steering.

The device consists of 512 x 320 individually addressable mirrors at 48µm pixel size. The actuators are designed to provide a 2 axis-tip-tilt motion allowing a continuous, analog deflection of up to 3.5° in arbitrary directions, fully calibratable at standard deviations of better than 0.025°.

They are realized within a 2-level architecture with 4 suspending flexure beams underneath and the mirror on top. Fabrication is done by surface-micromachining in a fully CMOS compatible process.

The mirrors are electrostatically activated by 4 underlying address electrodes. The required drive voltages are fed in via an integrated CMOS backplane supporting re-programming rates of up to 3.6 kHz.

For data transfer and control also an external drive electronics has been developed comprising a main unit and a satellite board hosting the MMA chip.

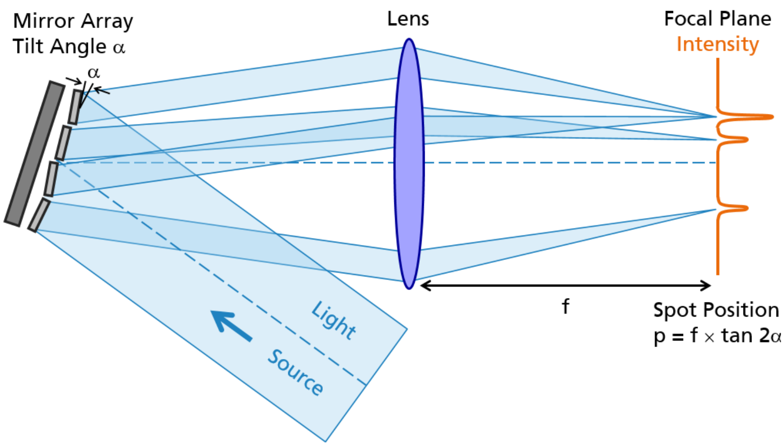


Ceramic-packaged 48µm, 512 x 320 Tip-Tilt Micro Mirror Array

Contact

Dr. Andreas Gehner
Tel. +49 351 8823-106
andreas.gehner@ipms.fraunhofer.de

Fraunhofer Institute for
Photonic Microsystems IPMS
Maria-Reiche-Str. 2
01109 Dresden, Germany
www.ipms.fraunhofer.de



3 *Optical principle: pixelwise redirecting of light*

4 *Examples of generated 2D intensity patterns*

Working Principle

The optical working principle relies on a pixel-wise re-distribution of light. Each mirror creates a beamlet that can be positioned arbitrarily within the focal plane of a subsequent lens. This might be used for a simple redirection of light beams or for the formation & control of variable 2D intensity profiles, patterns or shapes. Since there are no blocking or filtering elements involved, a higher light efficiency (higher brightness using lower powers) is facilitated.

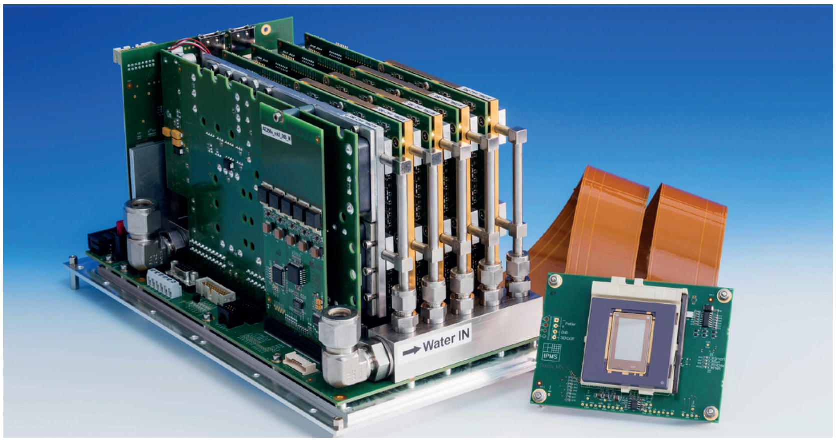
Possible Applications

- Laser Beam Shaping
- Laser Spot Tracking
- Programmable Illumination
- Laser Material Processing: Laser Ablation, Engraving or Cutting

Key Parameter

Parameter	Value	Remark
Array Format	512 x 320	optional: 342 x 213
Pixel Size	48 µm	optional: 72 µm
Array Area	2.5 x 1.5 = 3.8 cm²	
Deflection Range	3.5° in any direction	
Acccuracy (1σ)	< 0.025°	
Fill Factor	> 92%	
Reflectance	> 85% (DUV - IR)	wavelength-tuning possible
Light Power Density	< 50 W/cm²	typical range*
Chip Frame Rate	3.6 kHz	
Chip Power Dissipation	10 W	
Ext. I/F Data Rate	20 Hz	upgrade option to 3.6 kHz

**: actual value may differ depending on specific irradiation conditions*



Complete system: micro mirror chip with external drive electronics