Fraunhofer
ISIT

Paper-Präsentationen von Fraunhofer ISIT auf der
SPIE Photonics West 2020
Samstag, 1. Februar 2020, 9:00 – 11:50 Uhr
Location: Room 204 (Level 2 South)

Session 1: Micro-mirrors
A triple-wafer-bonded AlScN driven quasi-static MEMS mirror with high linearity and large tilt angles
Paper 11293-3

Vortragende: Shanshan Gu-Stoppel
Saturday, 1 February 2020, 9:00 AM - 9:20 AM
Location: Room 204 (Level 2 South)

Autoren: Shanshan Gu-Stoppel, Thomas Lisec, Maria Claus, Nico Funck, Simon Fichtner, Saskia Schröder, Bernhard Wagner, Fabian Lofink

Abstract
In the previous work a quasi-static MEMS mirror with a novel design and powerful piezoelectric driving material of AlScN was shown, which possesses large mechanical tilt angles of up to ±12.5°, high frequency of about 1 kHz, high fill-factor (aperture diameter is 0.8 mm and die size is 1.3 x 1.1 mm2), great long-term stability and great linearity. In this paper further developments are discussed, to improve the performance of the of AlScN actuators, and specifically to integrate the mirror plates onto the actuators by a BEOL wafer bonding process instead of hybrid assembly. To achieve a high fill-factor and a good mechanical linearity the mirror plate and actuators are stacked on different wafers. Even more, a third wafer of TSV wafer is used for the vertical electrical contacts. This paper will show the process efforts for realizing the bonded triple-wafer-stack and discuss the technological challenges and achieved results.

Fraunhofer ISIT

Session 1: Micro-mirrors

A bi-axial vacuum-packaged piezoelectric MEMS mirror for smart headlights

Paper 11293-4

Vortragende: Shanshan Gu-Stoppel
Saturday, 1 February 2020, 9:20 AM - 9:40 AM
Location: Room 204 (Level 2 South)

Autoren: Frank Senger, Jörg Albers, Gundula Piechotta, Thorsten Giese, Felix Heinrich, Shanshan Gu-Stoppel, Fraunhofer ISIT; Ulrich Hofmann, Thomas von Wantoch, OQmented GmbH

Abstract
This paper presents a MEMS mirror for smart headlights, combing high-Q vacuum package with AR-coating, piezoelectric driving and Lissajous scanning. While the vacuum package protects the MEMS device and the AR-coating suppresses parasite reflections from the glass lid, the AlN-based piezoelectric actuators are robust against shock and vibration during driving. This MEMS mirror with a large circular aperture (diameter = 5.5mm) utilizes Lissajous scanning possessing two perpendicular torsion modes with frequencies of 2.26kHz and 2.30kHz fulfilling high light density and large total optical scanning angles of 55°, 30° at ±40V. A 2D projection of 50°x20° was realized, where the angle loss comparing to the 1D testing arose from pincushion distortion. Due to the great long-term stability of AlN and protection of vacuum packages, the MEMS mirror also shows a good reliability. This paper will describe and discuss about the design, fabrication and characterization results of this MEMS mirror.

Session 2: LIDAR

Resonant 1D MEMS mirror with a total optical scan angle of 180° for automotive LiDAR

Paper 11293-8

Vortragende: OQmented GmbH (spin-off of Fraunhofer ISIT)
Saturday, 1 February 2020, 11:30 AM - 11:50 AM
Location: Room 204 (Level 2 South)

Autoren: Frank Senger, Jörg Albers, Pauline Malaurie, Felix Heinrich, Dirk Kaden, Hans-Joachim Quenzer, Fabian Lofink, Fraunhofer ISIT; Christian Janicke, Leon Pohl, Fabian Schwarz, Thomas von Wantoch, Ulrich Hofmann, OQmented GmbH

Abstract
Presented here is the world's first resonant 1D MEMS mirror achieving mechanical scanning angles exceeding ±45° and thus providing a field-of-view of up to 180°. The MEMS scanner features a 2 mm x 4 mm ellipsoid mirror plate and oscillates at a scan frequency of about 1.5 kHz. Integrated sensors and closed-loop control allow for an accurate position detection below 0.1°. To achieve the scan angles as well as guarantee long lifetime and reliability the MEMS mirror is hermetically sealed by a dedicated glass cover and operated in vacuum.