

# MEMS-on-CMOS-Integration of Spatial Light Modulator for Holographic MR/AR Applications

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## Abstract

As a highly specialized R&D institute for optical MEMS, Fraunhofer IPMS presents a process flow for the hetero integration of a micro mirror spatial light modulator (SLM) for application in mixed and augmented reality. The SLM consists of an 8MPixel micro mirror array with a pixel size of  $4\mu\text{m} \times 6\mu\text{m}$ . It is integrated on a 180nm-node foundry-assembled CMOS-wafer. We use a double-spring comb drive actuator for piston mode, which enables a highly linear response curve to achieve precise adjustment of the stroke for variable wavelengths in VIS. It is made of 6 metal layers patterned mainly by KrF-Lithography and uses plasma-enhanced CVD-USG for sacrificial layers. The sacrificial material is subsequently released by gaseous Hydrogen fluoride on chip-level. Special challenges of the process flow are the initial planarization of the CMOS-wafer, optimization of sputter deposition for ultra-thin springs i.e. thickness uniformity and stress tuning, uniformity of the deposition and CMP for sacrificial layers. As for the pixel size MEMS fabrication aims for precision in lithography and patterning, to fulfill high requirements in overlay and CD-uniformity. Details of the full MEMS process-flow are presented as well as results from inline characterization.

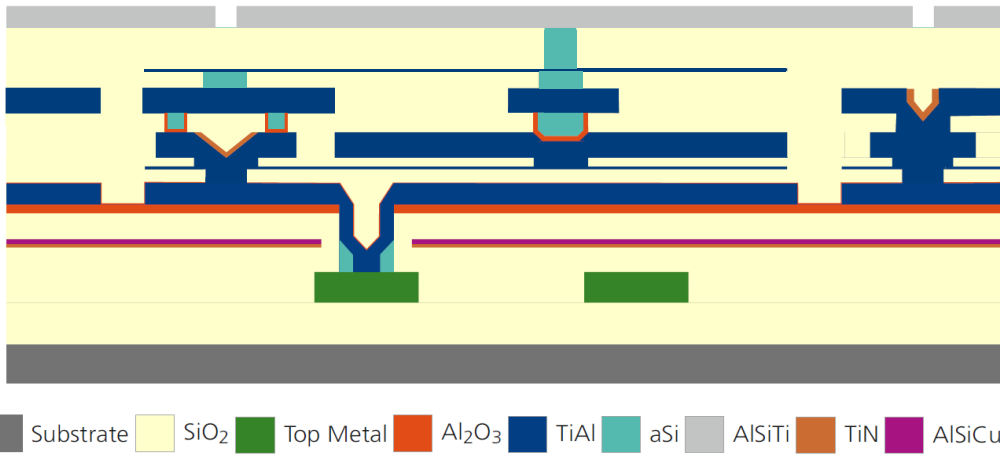


Fig.1: Cross section of the MEMS-part for a single pixel of the SLM.

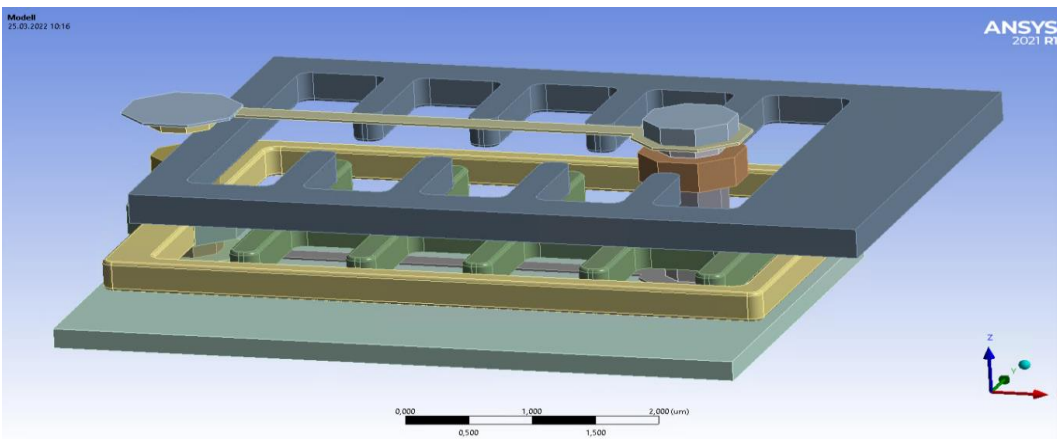


Fig.2: 3D-Modell of the actuator using a 5-Finger design of the comb drive and additional cross-talk-shield.

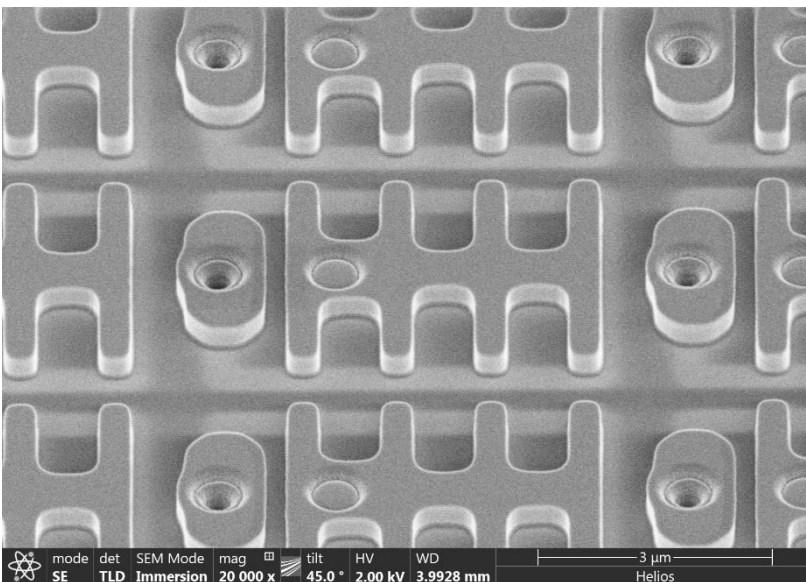


Fig.3: SEM-image of a 4-finger yoke after patterning.