Silicon-glass platform for vertical multi-wafer integration of optical microsystems: applications in on-chip microscopy

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Abstract

We describe a technological silicon-glass platform developed for miniaturization of optical microsystems with special emphasis for MOEMS-based imagers, such as laser scanning confocal microscopes or Optical Coherence Tomography (OCT) microsystems. The platform employs multi-wafer vertical integration approach, combined with glass-based micro-al components and heterogeneous bonding and interconnecting technologies. In this contribution we focus on the unconventional fabrication methods of monolithic microoptical structures and components in borosilicate glass (e.g. micro-beamsplitters, refractive microlenses) for optical beam shaping and routing. We use this technology to build 3D microoptical scanners for miniature confocal microscope and 1D scanner for active Mirau micro-interferometry used as a key element of a swept-source OCT microsystem..

As an illustration two different microsystems based on Mirau interferometry and applied for swept source OCT imaging will be demonstrated: one for dermatology and second for gastroenterology. In both cases the architecture is based tem based on spectrally tuned Mirau interferometry. The first configuration, developed in the frame of the European project VIAMOS, includes an active array of 4x4 Mirau interferometers. The matrix of Mirau reference mirrors is integrated on top of an electrostatic vertical comb-drive actuator. In second configuration, developed in the frame of Labex ACTION, we adapted VIAMOS technology to develop an OCT endomicroscope with a single-channel passive Mirau interferometer.