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Technologies for fabrication of MEMS, optics and photonics at the micro- and nanoscale continue to advance and diversify due to rising demands for miniaturization, cost reduction, functional integration, and increased performance. Examples include diffractive optics, sub-wavelength optics, microrefractive optics, optical waveguides, photonic crystals, plasmonic devices, and heterogeneously integrated active and passive micro- and nano-optical devices. These devices are playing increasing roles in a wide range of applications, including sensors and actuators, communications, imaging, biomedical, data storage, and other areas. Both conventional and unconventional micro- and nanofabrication techniques serve as fundamental enablers for wide ranges of MEMS and passive and active optical components and devices.

In order to enable new products using these new technologies, basic research must be carried out. New materials must be characterized and synthesized, new manufacturing technologies proved out and new prototype devices designed. Our special issue provides examples of exciting research in these areas. We see these new technologies as part of a manufacturing renaissance that is taking place worldwide, where there is high interest in exploring new fabrication technologies and bringing them to market. Of course, micro- and nanofabrication for photonic structures have many more facets than a single special issue can cover. Nevertheless, we present here a special selection of papers presented at Photonics West in 2013. All of the papers are dedicated to precise fabrication but do not directly follow the common approaches.

The paper by Grbovic et al. reports on the characterization of metal-organic hybrid metamaterials for MEMS-based terahertz (THz) thermal sensors and on characterization of the refractive index of SU-8 in the THz band. These imagers may present a much safer alternative to full body scanners. They investigated metamaterials consisting of an Al ground plane and a layer of patterned Al separated by a dielectric spacer SU-8. This type of metamaterial, coupled with the applicability of SU-8 as a structural material, offers possibilities for quick, simple microfabrication of THz imagers. SU is a low-cost material that can quickly be spun onto a substrate at a wide range of thicknesses, and then photolithographically patterned. It is also transparent to THz radiation and thus a suitable choice for a dielectric spacer in metamaterials.

Lange et al. present the fabrication, replication and wafer-level imprinting of a polynomial curvature. This manufacturing technique enables the realization of an electrostatic out-of-plane zipper actuator with considerably altered and enhanced voltage vs. deflection behavior. They achieve this result by using a UV-curable polymer, instead of the usual silicon. The paper presents the design of an actuator with an integrated micromirror. The diamond turning of the master mold and the wafer-level fabrication process of the polynomial curvature is explained in detail and realized by unconventional wafer level imprinting of an UV-curable, non-conducting polymer.

Stiction occurring in the release phase of the fabrication sequence of MEMS devices can be a severe problem. In the paper by Mulloni, Faes, and Margesin, the possibilities and the limits of the use of solvents with low surface tension are investigated with the application to MEMS resonators made on SOI substrates. The paper shows that for this device it is possible to obtain stiction-free structures without the necessity of more expensive and complicated techniques such as supercritical drying or HF vapor etching.

In the paper by Kumar et al., the authors present a very interesting low-cost approach for the fabrication of hard-masks for photolithographic structuring, allowing for laboratory level fabrication. Instead of using expensive laser-written masks they utilize precision manufactured aluminum shadow masks which are subsequently highly demagnified to transfer the patterns onto chromated glass slides.

Reliable fabrication of solid-immersion lens arrays plays an important role for the fabrication of, e.g., wave-front sensor devices. With increasing resolution of the detectors, the size of the lenses further reduces, increasing the requirement on the overall precision of the single solid immersion lens. As Kim et al. demonstrate in their paper, solid immersion lens sizes on or below the wavelength scale are almost insensitive to deviations from the ideal spherical shape. To demonstrate this effect, the authors fabricate nanostructures of various shapes by electron-beam lithography. Employing a reflow step, these structures are incompletely melted, resulting in nonspherically shaped solid immersion lenses. The authors demonstrate that due to the small size, aberrations do not play a significant role and focusing capabilities are comparable to perfect structures. Tolerances for the fabrication of nano-solid-immersion lenses are therefore relaxed.

Even smaller objects are of importance in the paper of Park et al. The authors concentrate on patterning of colloidal quantum dots with nanometer resolution allowing for precise placements of emitters in nanophotonic devices. While several techniques have been presented during the last years, they are hardly compatible with today's CMOS processes. The authors circumvent this limitation by adapting a conventional lift-off method for the patterning of colloidal quantum dots, demonstrating various shapes formed by colloidal quantum dot clusters, such as straight lines, rings, and dot patterns with sub-100 nm size. As a first application of the method, a surface plasmon generator driven by a quantum dot cluster is presented.

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