

Editorial

Special Issue on Microlenses

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The study and application of microscale lenses and lens arrays have been actively researched in recent years; new approaches in the fabrication of microlenses and microlens arrays have emerged. Also, novel applications of these microlenses and microlens arrays have been demonstrated. In an effort to disseminate the current advances in this specialized field of microlenses and microlens arrays, and to encourage discussion on the future research directions while stimulating research interests in this area, a Special Issue of *Micromachines* has been dedicated to “Microlenses”.

This Special Issue presents a total of ten papers covering most of the active areas of research in microlenses and microlens arrays. Specifically, eight papers are on the fabrication and characterization of microlenses and microlens arrays, one focuses on integration of microlenses into complex micro-optical modules, and the last one deals with the super-hydrophobic surface that is often important to realize droplet-based microlenses.

The fabrication and realization of microlenses and microlens arrays reported in these papers, cover a wide range of mechanisms, technologies, materials, and optical designs. Xu *et al.* [1] provide a thorough review of how to improve the response time of liquid crystal (LC) based tunable-focus microlenses. The basic operating principles and recent progress are introduced and reviewed for two types of fast-response microlenses based on LC/polymer composites: polymer dispersed/stabilized nematic LC and polymer-stabilized blue phase LC. Chen *et al.* [2] propose a polarization independent LC microlens arrays based on controlling the spatial distribution of the Kerr constants of blue phase LC; the concept is supported by simulation. Two papers are on adaptive liquid lenses actuated via electrowetting. Liu *et al.* [3] report a design in which the liquid lens is tuned by electrowetting-driven movement of a droplet. Li *et al.* the authors of [4] describe a variable-focus liquid microlens that is actuated by electrowetting on dielectric (EWOD). The microlens is fabricated on a flexible and curved polydimethylsiloxane (PDMS) substrate. Mohammed *et al.* [5] utilize CO₂ laser to manufacture miniaturized plano-convex lenses by an engraving process in poly(methyl methacrylate) (PMMA) substrates. Such lenses can be integrated into lab-on-chip systems. Gulari *et al.* [6] demonstrate a microfluidic-based oil-immersion

lenses (μ OIL) chip as an add-on chip-based optical module to provide high-resolution and large field of view to a stereo microscope. Aldalali *et al.* [7] report an approach to fabricating PDMS microlenses and microlens arrays through a single molding step. The mold is formed by photo-polymerization, and the resultant shrinkage, of polyacrylamide (PAAm) hydrogel. Finally, Huang *et al.* [8] present a wide-angle, broad-spectrum cylindrical lens based on reflections from a micro-mirror array, rather than refraction. This intriguing mechanism is inspired by the reflecting superposition compound eyes of some decapods.

There are two papers in this Special Issue covering different aspects of research related to microlenses and microlens arrays. Dannberg *et al.* [9] discuss wafer-level hybrid integration of complex micro-optical modules. Microlenses play a critical role in the formation of these modules. Gentile *et al.* [10] provide a review of super-hydrophobic surfaces (SHSs)—bio-inspired, artificial microfabricated interfaces consisting of nanoengineered micropillars. Such SHSs could benefit many optical components and modules, including microlenses.

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