Continuous Achromatic Flat Subwavelength Grating Lens over whole Visible Bandwidths

Mao Ye[1], Vishva Ray,[2] Ya Sha Yi[1,3]

[1] Integrated Nano Optoelectronics Laboratory, University of Michigan, 4901 Evergreen Rd., Dearborn, Michigan, 48128 USA
[2] Lurie Nanofabrication Facility, Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, Michigan 48109-2122, USA.
[3] Energy Institute, University of Michigan, 2301 Bonisteel Blvd., Ann Arbor, Michigan, 48109, USA.

Emerging applications in the fields of imaging, sensing, spectroscopy, and photovoltaics have seen a rapid development of metasurface photonic devices in various aspects including design, fabrication, and characterization. Typically, a high index contrast grating is used as individual phase shifter to satisfy the lens focusing requirements, as it can provide relatively large phase shift from 0 to 2π so that the light focusing condition can be met. However, the high index contrast gratings gives rise to a significant chromatic behavior of the micro lens and achieving achromatic focusing over certain bandwidths has been a challenge.

We present the results from simulation, fabrication, and characterization of a novel achromatic micro lens with low-index contrast based nano structures. The fabrication of these nanostructures was optimized using electron-beam lithography to achieve the critical dimensions and maintain the uniformity. The as-fabricated micro lens demonstrated less than 5% of focal shift over whole visible wavelength (435 nm to 685 nm).

The simplicity of our approach, combined with the fact that it can be directly integrated with current CMOS technology is a critical step to achieve the ultimate goals expected from the flat micro lens.