Multi-dimensional Optical Field Manipulation Based on Dielectric Metasurfaces: Materials, Fabrication, and Applications

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Metasurfaces are planar arrays of subwavelength electromagnetic structures that collectively mimic the functionality of much thicker conventional optical elements, and are considered as promising solutions for building the next-generation optical systems with reduced footprint and enhanced functionality. In this talk, I will present a few of our recent works on multi-dimensional optical field manipulation based on dielectric metasurfaces. I will first show how low-loss metasurfaces operating at ultraviolet (UV) wavelengths down to the deep-UV range can be implemented using wide-bandgap dielectric materials such as Hafnium Oxide (HfO_2)[1] and Tantalum Pentoxide (Ta_2O_5).[2] I will then present a novel resist-template based Damascene lithography process incorporating low-temperature atomic layer deposition, which has been successfully utilized to create high-performance dielectric metasurfaces operating in the UV and visible regions.[3] In the end, I will present several examples illustrating the versatility of dielectric metasurfaces in enabling multi-dimensional optical field manipulations. These examples include edge-enhanced imaging, multi-channel holographic display,[4] and flat-top beam generation.

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