Meta-waveguides: a marriage between metasurface and integrated photonics enabling subwavelength control of guided waves

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Abstract

Metasurfaces with unparalleled light controllability have shown great potential to revolutionize conventional optics. However, they mainly require free-space light excitation, making it challenging to integrate them on-chip fully. Here, we present metasurface-incorporated waveguides that synergize subwavelength metaphotonic architectures with photonic integrated waveguide platforms. Such meta-waveguides achieve various functions in a completely integrated platform, such as steering and focusing guided waves into free space, projecting holograms with controlled phase and amplitude control, and generating laser emission carrying orbital angular momenta. Our study shows a viable route toward complete control of light across integrated photonics and free-space platforms and paves the way for creating multifunctional photonic integrated devices with agile access to free space.