Active Meta-Optical Fibers

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Optical metasurfaces represent an important avenue towards novel optical functionality and innovative applications, thanks to their exceptional capability to manipulate the phase, amplitude, and polarization of transmitted, reflected, and diffracted light. Since their first integration onto the optical fiber endfaces a decade ago, the resulting "meta"-optical fiber platform has demonstrated immense potential, both in exploiting the strengths of optical fibers and overcoming their limitations, enabling revolutionary next-generation photonic devices.

In this talk, I will review the various material platforms (metallic, dielectric, and compound structures) and geometric platforms which have been utilized in "meta"-fiber devices to date. I will present our recent development of "Meta"-optical fiber, an advanced optical fiber integrated with emerging metasurface concepts. I will present the development of ultrathin optical metalens which is cascaded on the facet of optical fiber that enables advanced optical functions via wavefront shaping such as light focusing. I will also discuss the ability to develop tunable meta-optical fiber for advanced beam steering and dynamic focusing, and their potential application for biomedical imaging. These advanced "meta"-optical fibers open a pathway to revolutionary in-fiber optical imaging/endoscopy, biomedical imaging, lasers/spectroscopies, and optical/quantum communication devices.