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# Metasurface-enhanced fiber for extraordinary light coupling

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Remote collection and analysis of light is highly important for a plethora of applications including spectroscopy, endoscopy, biosensing, quantum communications, etc. Commercial optical fibers are the best platform for this purpose due to their ability to operate in strongly limited and closed spaces (particularly, in-vivo) in a wide range of environments and external conditions. The payback of this advantage is the low coupling of the incident light into fiber under oblique incidence. Practically, the efficient light coupling into fiber modes is possible only for incident angles less than 15 degrees.

Here, we propose to overcome this fundamental limitation by upgrading the fiber tips with axial-symmetric all-dielectric nanostructures. Namely, we demonstrate the enhancement of light in-coupling efficiency by several orders of magnitude at almost grazing incidence for the fibers empowered with coaxial silicon nitride nanorings [1]. This research was highlighted among "the most exciting research in optics and photonics in 2021" according to Optics & Photonics News journal [2]. Even more advanced polarization- and angle-independent in-coupling may be achieved with polymer aperiodic nanostructure implemented using 3D nanoprinting technique.

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[1] O. Yermakov et al., ACS Photonics, 7(10), 2834-2841 (2020).
[2] O. Yermakov et al., Optics & Photonics News, December 2021.

## Topics

Session C. Applied optics and engineering

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