Superresolution imaging based on high-refractive-index optical fiber bundles

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Abstract: During the past few years, we introduced different elements and instruments of THz waveguide and fiber optics based on sapphire shaped crystals [1–4]. Such crystals are fabricated using the Edge-defined Film-fed Growth technique in ISSP RAS. Recently, we developed a "THz focons", [5] or bundle, based on the array of sapphire fibers with n>3, that capture the THz near-field with the resolution which overcome the Abbe diffraction limit. The parallel fiber bundle transmit the THz image from plane to plane with mean value of 0.53 λ of spatial resolution, while, at certain regions of the bundle, it is as low as 0.3λ [6]. The tapered high refractive index fiber bundle transmit the THz near field from sample to image plane with the resolution as high as 0.25–0.3λ and, then, scales it by a factor of 3 [7]. This makes possible to read out the THz near-field from the output facet of the bundle using conventional diffraction limited optics. Thus developed "THz focon" allows to overcome the Abbe diffraction limit and to perform the THz near-field imaging using common diffraction-limited lens- or mirror-based THz optics.

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