Suspended core subwavelength fibers for practical low-loss terahertz guidance

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Abstract: We describe fabrication of polymer suspended core fibers (porous & non-porous cores) for terahertz guiding, and their characterization via near-field THz microscopy. These novel fibers enable convenient handling and mode isolation from perturbations.

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1. Introduction

Dielectric subwavelength fibers have demonstrated single-mode terahertz propagation losses below 0.02 cm^{-1}. However, because of the highly delocalized fields, subwavelength fibers suffer from high sensitivity to the surrounding environment and are difficult to manipulate or hold in place without disrupting the terahertz signal [1].

In this paper, we propose a novel type of terahertz dielectric waveguide to address this problem: the suspended core fiber. We here demonstrate the ability of these fibers for low-loss guiding of terahertz radiation in isolation from external disturbances. Our results suggest that dielectric suspended core fibers are excellent candidates to provide practical terahertz signal delivery for THz imaging/sensing applications.

2. Fabrication and characterization of polymer suspended core fibers

All fibers in this work were fabricated using commercial rods of low-density polyethylene. Both suspended core preforms were prepared using a combination of drilling and stacking techniques. We fabricated, using pressure-controlled drawing, one suspended *solid core* fiber of 5 mm outside diameter with a small 150 µm core diameter [Fig. 1(a)-(b)], and a suspended *porous core* fiber of 3 mm outside diameter with a large 900 µm core [Fig. 1(c)-(d)].

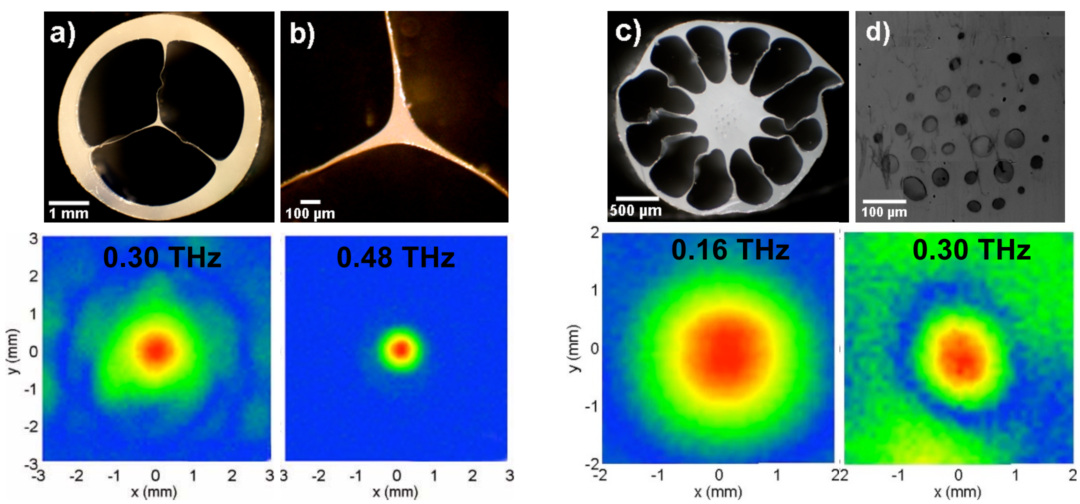

Fig. 1. First row: (a) cross-section of the suspended solid core fiber OD = 5 mm, with (b) close-up view of core (d_{core}= 150µm). (c) Cross-section of the porous core fiber OD = 3 mm, and (d) close-up view of the porous core (d_{core}= 900µm). Second row: output near-field microscopy images at selected frequencies corresponding to each fiber depicted on top row.

The modal and transmission properties of each fiber were characterized using THz near-field microscopy [2]. Both fibers support an effectively-single mode regime, and a transmission bandwidth over 0.17 THz. Moreover, thanks to the large fraction of air inside the porous outer cladding, propagation losses as low as 0.02 cm^{-1} are demonstrated.

5. References

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