

Title: Evaluation of THz wave transmission performance in TOPAS-based heptagonal photonic crystal fiber (He-PCF)

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Abstract: PCF denotes photonic crystal fiber which is utilized for terahertz (THz) waveguides and cladding in the shape of a hexagon with two elliptical air apertures (AHs), which are discussed. Such differentiation is made: When the frequency is 1 THz, effective material loss (EML) to a minimum of 0.028 cm^{-1} has been achieved. Making use of the heptagonal photonic crystal fiber (He-PCF) architecture, every simulation result utilizing COMSOL Multiphysics software implements the perfectly match layer (PML) and finite element method (FEM) boundary conditions. The He-PCF fiber demonstrates an effective mode loss (EML) of 0.028 cm^{-1} that is negligible, a substantial effective area (EA) measuring $7.31 \times 10^{-8} \text{ m}^2$ and an 80 % power concentration encompassing the central area at 1 THz frequency. Furthermore, regarding crucial optical guiding aspects like confinement loss, dispersion, and modality, a small study with respect to power fraction along with effective mode area (EMA) has again been conducted. Here, He-PCF THz waveguide is anticipated to provide a notable improvement in the current design for the communication field. Moreover, our suggested the PCF demonstrates perception by a solitary mode, as indicated through the utilization of the V-parameter, across a range in frequency spanning among 0.80 and 3 THz. Thus, it is anticipated that the layout of He-PCF fibers will facilitate efficient transmission of terahertz (THz) signals in a variety of communication applications.

Keywords: Low EML, Confinement loss, Optical fiber, Single mode H-PCF, THz regime

DOI: <https://doi.org/10.1016/j.heliyon.2024.e25622>