Manifestation of propagation traits for polymer square lattice micro-structured optical fiber in THz regime: a simplified model

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Research Article

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Abstract

To sustain the pace with immense prominence, interest in low-loss terahertz (THz) waveguides increases due to their particular applications in the multidisciplinary arena. This paper narrates a novel solid-core polymer-based square lattice micro-structured optical fiber (SL-MOF) with circular air-holes for efficient propagation of THz waves. The anticipated model's guiding attributes are described by employing the numerically efficient finite-element method (FEM) in conjunction with an auxiliary Ring Model. Numerical analysis of the model exhibits confinement loss of about ~ 10 -7 dB/cm and low effective material loss of ~ 0.19 cm -1 at the applied frequency of 1.0 THz. It is also demonstrated that the considered geometry furnishes low bending loss over the extended range of THz frequency. The relative sensitivity coefficient is evaluated in context for the targeted design parameters to enable the said model's practical utility. Other nameworthy propagation characteristics, such as effective mode-index, power fraction, effective mode-area, numerical aperture, spot-size, and the beam divergence are also investigated. The improved outcomes are anticipated that the proposed configuration will be opened a new epoch in the THz waveband.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and accessed as a PDF.

Figures

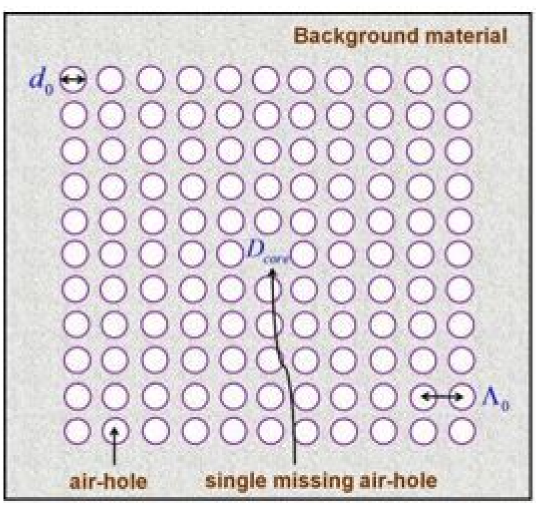

Figure 1

Schematic sketch of SL-MOF possessing 4-fold rotational symmetry.

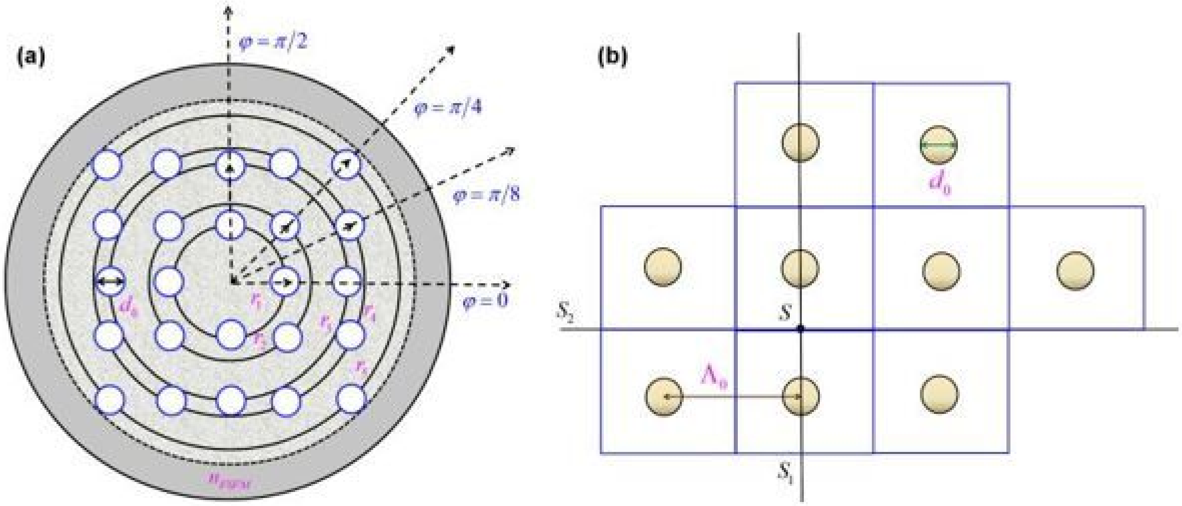

Figure 2

(a) Schematic diagram illustrating dielectric cross-section for SL-MOF, and (b) cladding structure (as decorated diagrammatically) with square unit cells. S1 and S2 designate the planes of symmetry as delineated by straight lines.

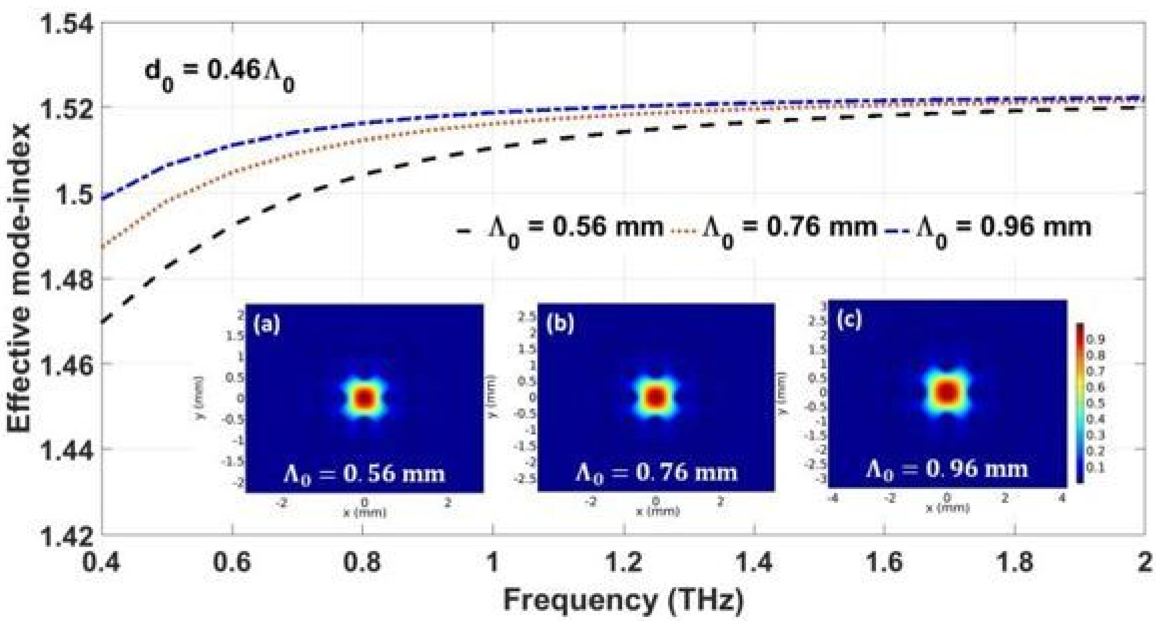

Figure 3

Comparison of effective mode-index of principal core-mode for SL-MOFs and inset delineates the near-field pattern at 1.0 THz.

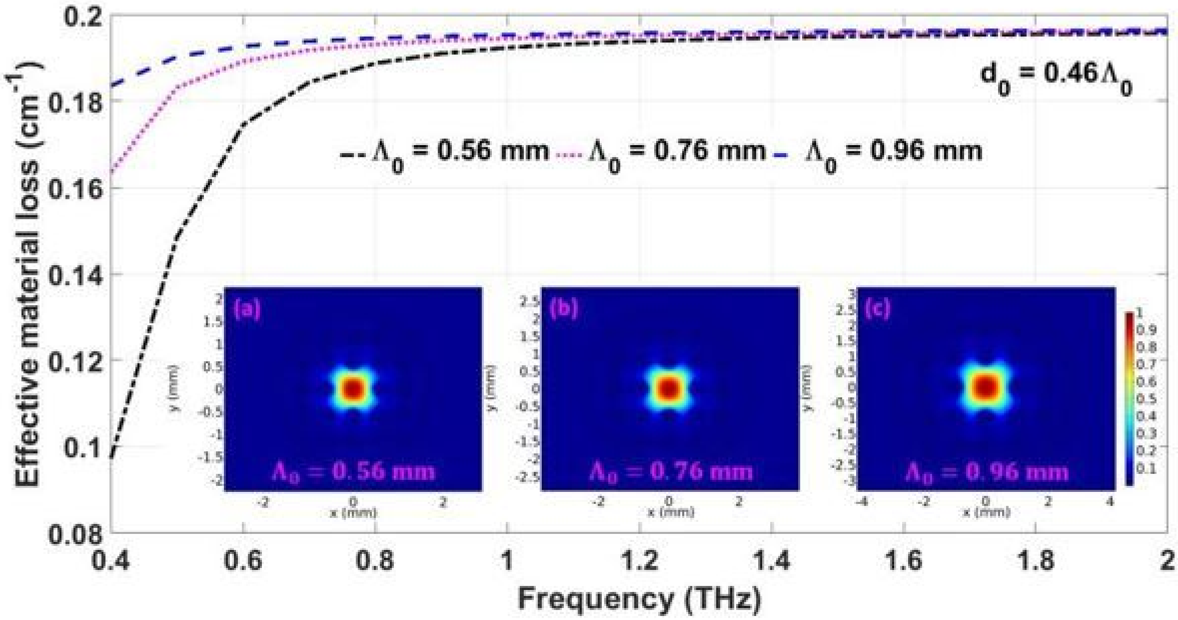

Figure 4

Due to technical limitations, the legend for this figure can be found in the manuscript.

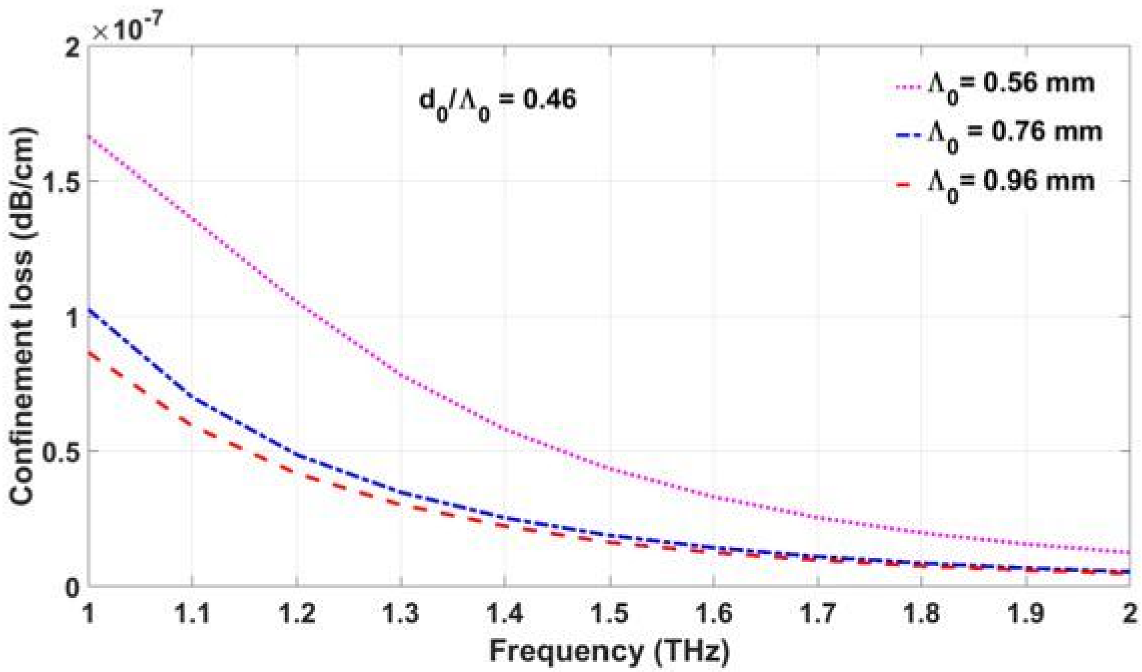

Figure 5

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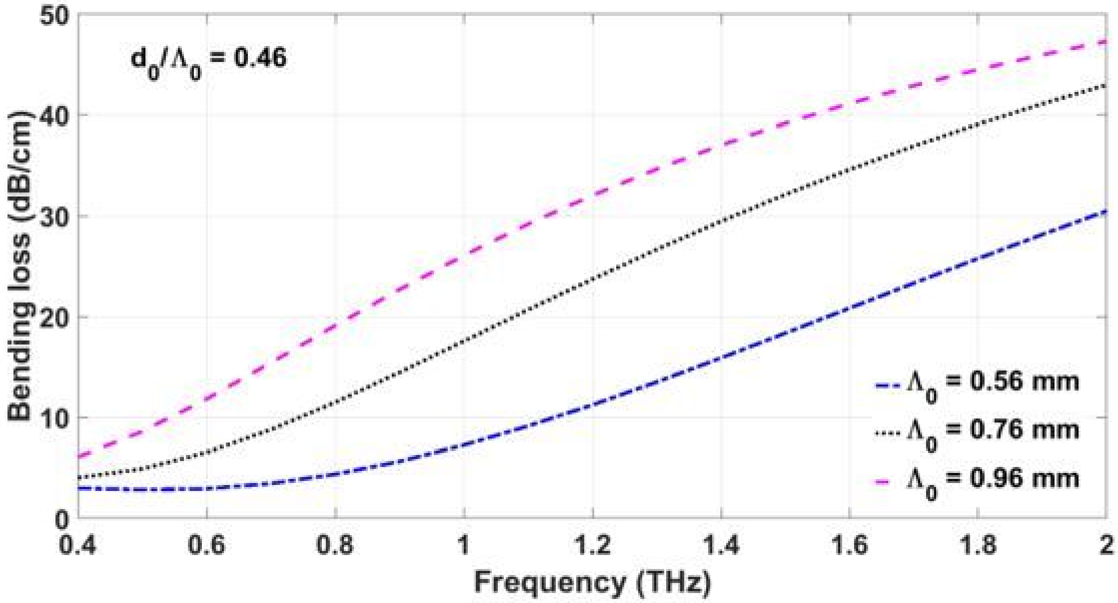

Figure 6

Bending loss (in dB/cm) against frequency (in THz) for the model.

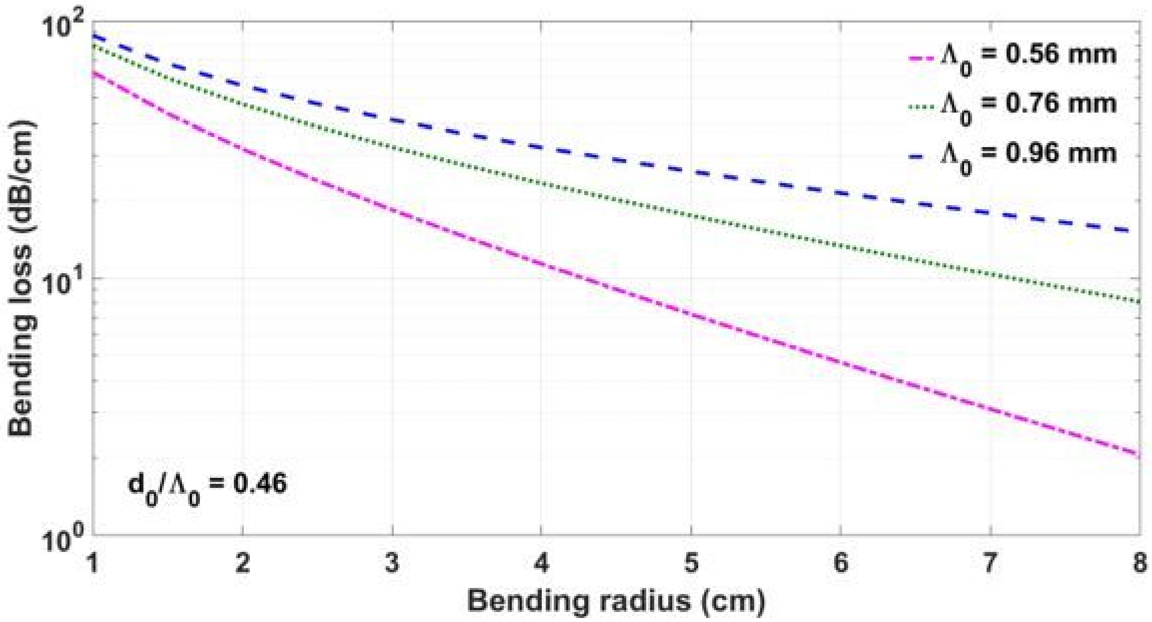

Figure 7

Bending loss (dB/cm) against bending radius (cm) for the model at f = 1.0 THz.

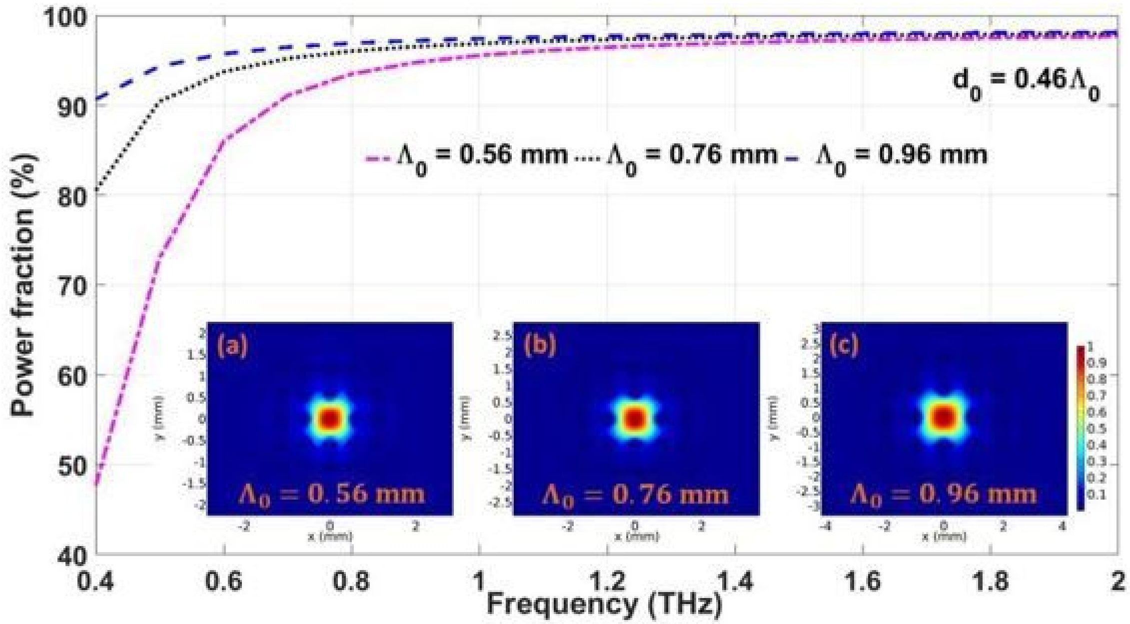

Figure 8

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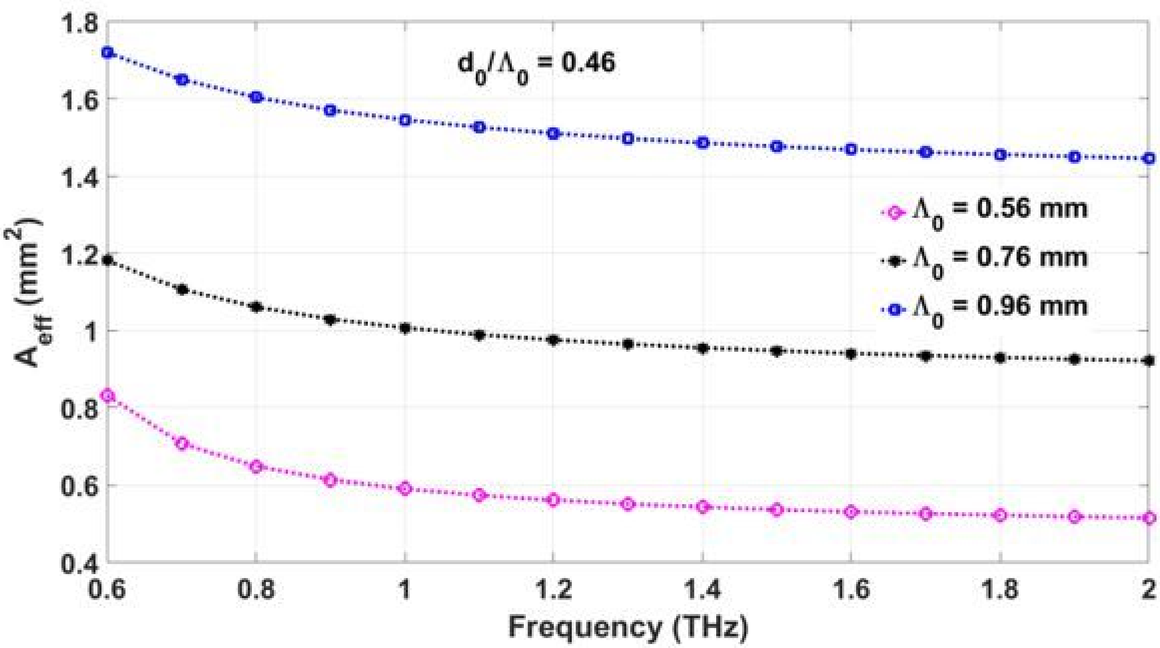

Figure 9

Frequency dependence of the mode-area for different pitch values at .

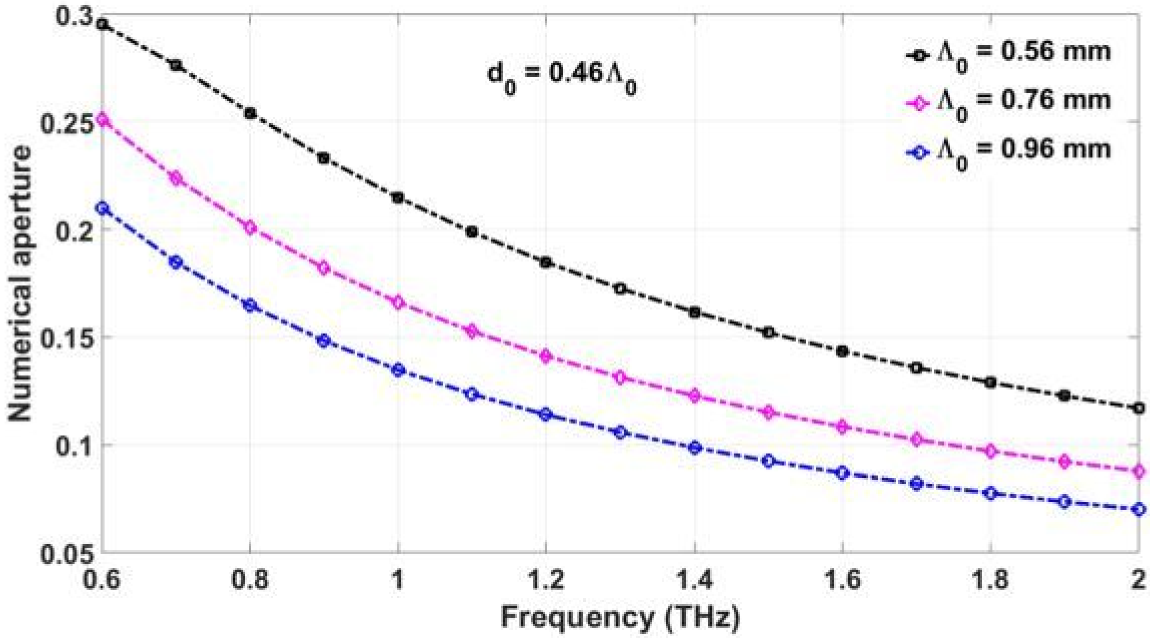

Figure 10

Depiction of numerical aperture against frequency for the anticipated model.

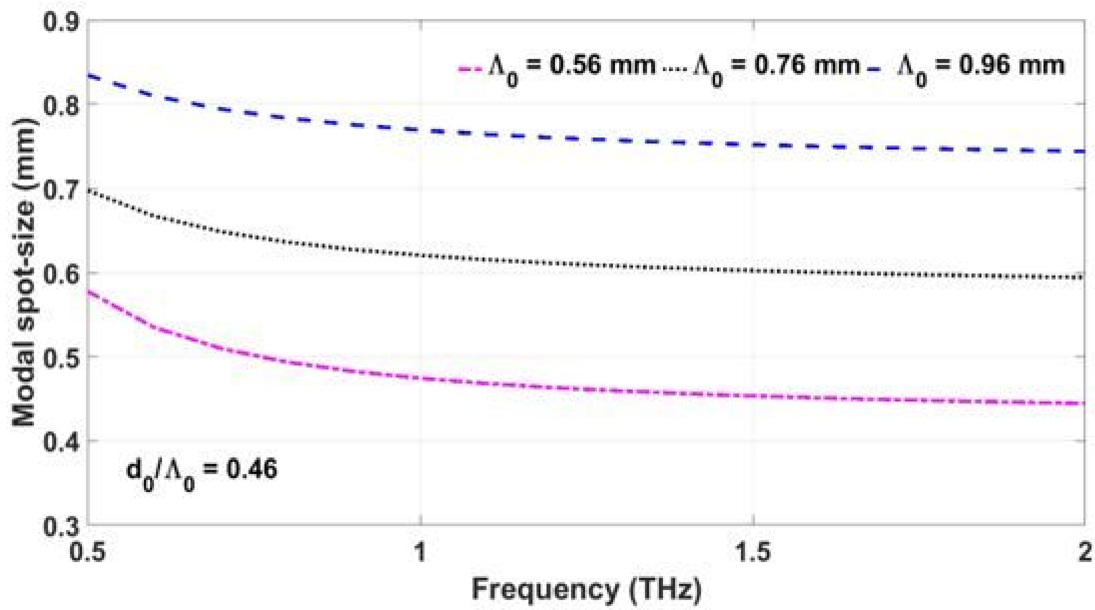

Figure 11

Depiction of modal spot-size against frequency for the model.

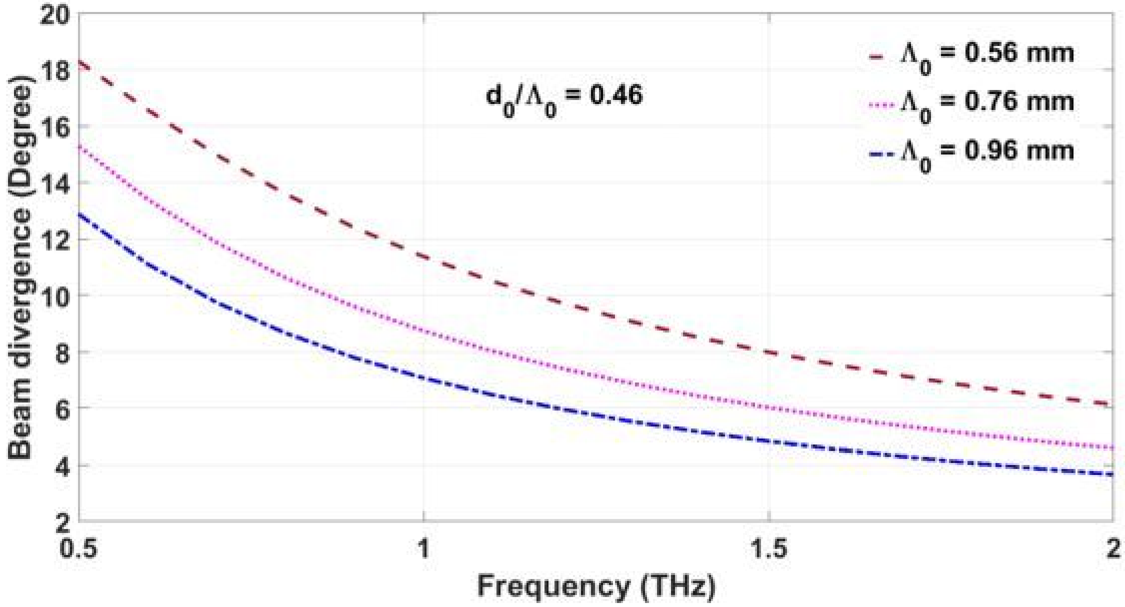

Figure 12

Beam divergence as a function of frequency for the model.

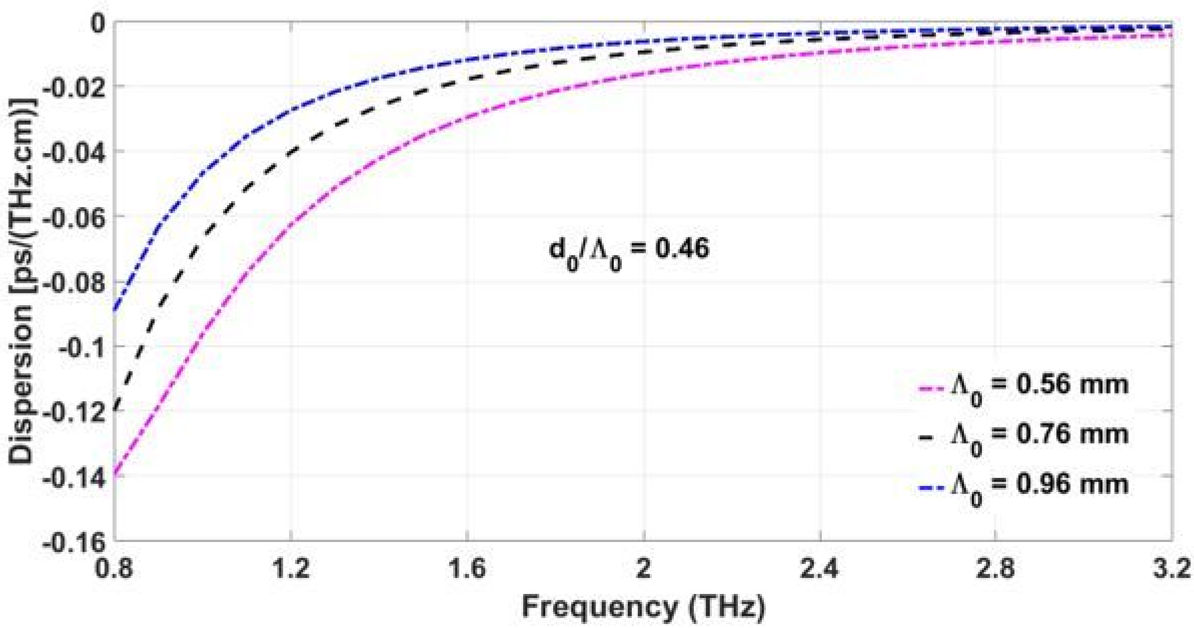

Figure 13

Relationship among dispersion and operating frequency for different pitch values.

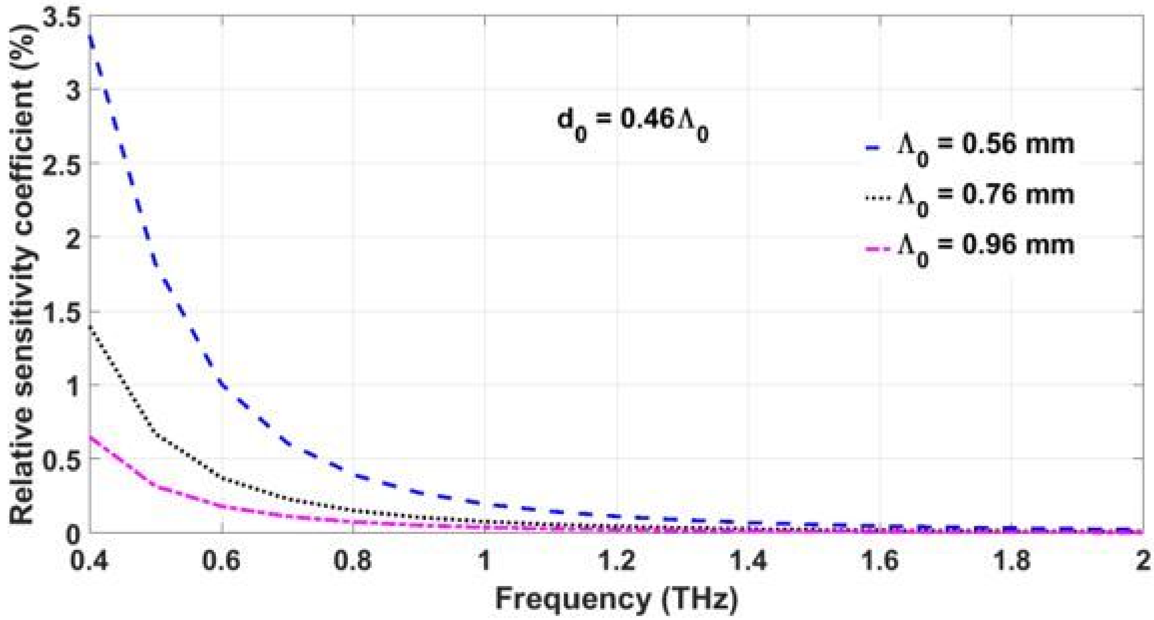

Figure 14

The response of relative sensitivity coefficient against frequency for the model.