# Dispersion Compensation in Terahertz Communication Links Using Metallized 3D Printed Hollow Core Waveguide Bragg Gratings


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**Abstract:** A novel terahertz (THz) waveguide Bragg grating is proposed for dispersion compensation. The results confirm single mode guidance of the fundamental mode, as well as large negative group velocity dispersion in the vicinity of 0.14THz.


## I. Introduction

In the past decade, various THz fibers with low transmission losses (<0.01 $cm^{-1}$), such as subwavelength fibers [1] and hollow core fibers [2], have been proposed and demonstrated, and thus loss reduction in THz fibers can be considered as a solved problem. However, dispersion management in THz fibers has been rarely studied and remains unsolved. In this paper, we propose a novel hollow core THz waveguide Bragg grating, which features periodic structures on its inner surface, for dispersion compensation in the terahertz frequency range.

## II. Results

The waveguide Bragg grating is realized by introducing triangular steps inside of a hollow core tube of diameter $D = 9.0\text{mm}$. Bragg grating comprises of 40 periodically arranged triangular steps of the base size $p = 1.35\text{mm}$ and the height of $h = 1.9\text{mm}$.

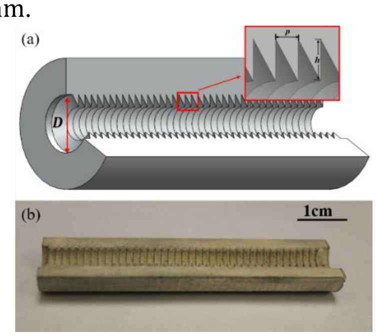


Fig. 1 (a) 3D schematic of the waveguide Bragg grating. Insert: zoom of the periodic structure. (b) One half of the dissected waveguide Bragg grating.

As shown in Fig. 2, in the 100-200 GHz range, there are several bandgaps of the fundamental $HE_{11}$-like mode and higher order modes opened by the Bragg grating. For the single mode operation, we observed that there are two such spectral regions, one is in the vicinity of 140GHz. The single modal operation ranges over 137-141GHz. While in the vicinity of 160GHz, the single modal operation ranges from 156GHz to 162GHz.

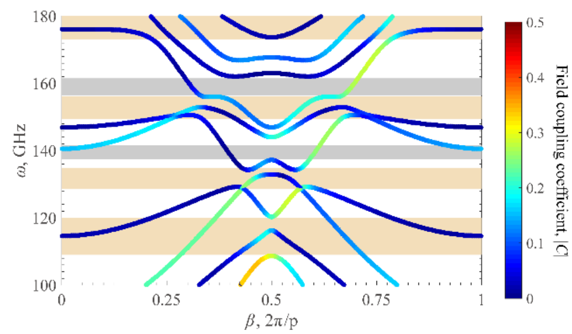


Fig. 2 Band diagram of the waveguide Bragg grating.

The fabricated waveguide Bragg grating is then characterized using a THz-CW system. The measured transmission and dispersion are shown in Fig. 3. In the frequency range of 100-200GHz, there are four low transmission windows with center frequencies of 118GHz, 135GHz, 153GHz, and 187GHz that have transmission losses in excess of 15dB. In the strict single mode regions, both theoretical and experimental results confirm the strongly negative dispersions. In the 137-141GHz range, dispersion varies from $-500$ to $-100\text{ps}/(\text{THz}\cdot\text{cm})$. At the same time, in the 156-162GHz range, dispersion varies from $-2000$ to $-60\ \text{ps}/(\text{THz}\cdot\text{cm})$.

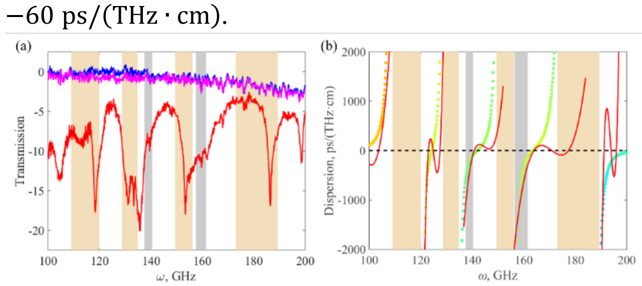


Fig. 3 (a) Measured transmission spectra of fabricated waveguides and (b) The comparison between the experimentally measured dispersion (red solid lines) and the theoretically computed dispersion.

Reference:


1. A. Hassani, A. Dupuis, and M. Skorobogatiy, “Low loss porous terahertz fibers containing multiple subwavelength holes”, Appl. Phys. Lett., vol. 92, pp. 071101-1-071101-3, 2008.
2. M. Skorobogatiy and A. Dupuis, “Ferroelectric all-polymer hollow Bragg fibers for terahertz guidance,” Appl. Phys. Lett., vol. 90, pp. 113514-1-113514-3, 2007.