GHz-FREQUENCY TRANSMISSION STUDIES OF THREE DIMENSIONAL PHOTONIC BAND GAP STRUCTURES

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Introduction

We report preliminary room temperature transmission measurements of three dimensional photonic crystals. The Photonic crystal structures in question are fabricated from high resistivity silicon in the manner reported by A. Chelnokov et. al. [1]. The silicon wafers that make up the structure are cut with a dicing to just over half depth in perpendicular directions on either side and stacked so as to form the ‘log pile’ structure shown in Figure 1. The dimensions are chosen so as to engineer a photonic band gap centered at a frequency of 203GHz.

Experimental

The measurements were made using a Millimeterwave Vector Network Analyser. The MVNA’s Schottky diodes, that act as source and detector, were coupled to each other via over-moded w-band wave guide. Central to this section of waveguide is a 7 mm air gap, into which the photonic crystal structure is inserted. To obtain absolute values of transmission the sample measurement is divided by a background measurement made with out the sample present. For these measurements the propagating direction was perpendicular to the silicon wafers. Future measurements with orthogonal and off axis propagation directions are planned in order to verify the three dimensionality of the band gap.

Results and Discussion

Figure 2 is the transmission spectrum through two similar structures, showing the low transmission region corresponding to the photonic band gap at predicted frequency range. Note that the lesser precision to which Structure 1 is manufactured results in a decreased width of the gap. The noise in this experiment has two predominant origins; The high frequency oscillations are introduced by the samples perturbation of the standing waves in the waveguide and the Schottky cavity, and the -40 dB noise floor which is due to cross talk from transmission at much lower MVNA harmonics at frequencies outside the band gap. Future experiments are planned to address these issues, by introducing horn antennas and narrower harmonic filtering.

References