A NOVEL METHOD FOR SWITCHING AND TUNING OF PBG STRUCTURES

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ABSTRACT: *Photonic band-gap (PBG) structures are utilized in microwave components as filters to suppress unwanted signals. In this work, rectangular perforations were created in the ground plane of a* *microstrip line to construct a PBG structure. A gold-coated alumina substrate was utilized to switch or tune the bandstop characteristics of this structure. It was demonstrated that the bandstop characteristics were switched off from −35 to −1 dB at 16 GHz. Tuning of the bandstop edge with a shift of 1.5 GHz was also shown.* Microwave Opt Technol Lett 43: 334–337, 2004; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.20462

Key words: *photonic band-gap (PBG); bandstop; microstrip; piezoelectric actuator; alumina substrate*

1. INTRODUCTION

The term "photonic band-gap" (PBG) was initially used in the optical regime when a strong reflection in a certain range of frequency was observed. Such a reflection is caused by periodic changes of dielectric layers with different index of refractions. Since the propagation of light is prohibited in such a frequency range, it is referred to as the "band-gap" [1–3]. This remarkable property has inspired several researchers to put their efforts into the development of PBG structures in microwave and millimeter-wave components [4].

Interest has been paid to microwave PBG structures because of their extraordinary features, for example, prohibiting electromagnetic waves to travel in frequencies within the PBG. In addition, the PBG structure is an attractive design because it can be integrated with microstrip transmission lines, not only to provide better performance, but also to reduce size and cost of the microwave and millimeter-wave components [5–8].

A good PBG design requires a large attenuation, controllable bandstop width, and a desirable central bandstop frequency. It has been reported that the bandstop characteristics are strongly correlated to the dimensions and arrangement of the lattice perforation patterns [9–12]. Also, it has been found that the lower edge of the bandstop has a strong dependency on the width of the perforation (d) and it shifts consistently towards lower frequencies as the width to period distance ratio (d/a) is increased, as shown in Figure 1 [9].

In addition, the electromagnetic fields are found to localize around the microstrip line since the bandstop performance is best when located at the center of the perforations [13]. However, it should be noted that the bandstop effect can still exist when the center of the microstrip line is not aligned to the center of the perforations. Therefore, by utilizing these properties, switching and tuning of the bandstop characteristics can be achieved by using a rectangular conductor and a piezoelectric actuator. The design setup of planar PBG structures employed in switching and tuning is first described, and then the simulation and measurement results are presented and compared.

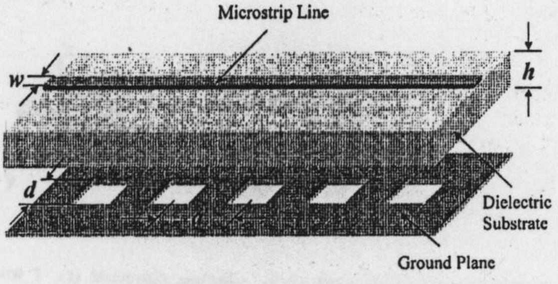

Figure 1 A planar PBG structure with the dimensions of lattice pattern and perforations shown

improved by optimization of EDF length. The laser does not appear at the output port, since it operates at wavelength of 1566 nm, which is outside the L-band region. This prevents the WDM system from being disturbed by the oscillating laser.

4. CONCLUSION

A new configuration of gain-clamped L-band EDFA has been proposed and demonstrated using a C/L-band WDM coupler. This configuration generates a laser at 1566 nm, which can be used for gain clamping. The gain for the amplifier is clamped at 15.5 dB with gain variation of less than 0.2 dB from an input-signal power of -40 to -14 dBm with a small noise-figure penalty. However, the flatness of the gain spectrum is slightly degraded due to the nonoptimisation of EDF length. The advantage of this configuration is that the oscillating light does not appear at the output port of the amplifier.

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