FDTD를 이용한 진행파형 Ridge-type CPW 다중 양자 우물 전계 흡수 변조기 분석

Analysis of Traveling-wave Ridge-type CPW MQW EA-modulator using FDTD

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ABSTRACT

Among many optical modulators, we are interested in traveling-wave(TW) multiple quantum well(MQW) electro-absorption modulator which can be used for wide-band applications, covering DC to 30GHz or higher frequencies. In this study, we simulate a 1.3mm InGaAs/InGaAsP TW MQW EAM using the 3D Finite Difference-Time Domain (FDTD) method. We identify that several geometric factors affect Microwave charateristics. Our calculated data provide useful information to optimize and fabricate ridge-type TW CPW EAM.

INTRODUCTION

The advent of millimeter-wave photonics requires high-speed external optical modulators. Electro-absorption modulator (EAM) is an attractive device in microwave-photonics because it can be fabricated in micro-stripe structure for microwave transmission and can be integrated with laser diode. Traveling wave (TW) type can offer much larger bandwidth than lumped type because it has no RC time constant limit. Therefore, many approaches for designing and optimization of the TW optical modulators have been recently reported for wide band applications[(1)-(2)]. In this study, structural optimizations of TW microstrip EAM and ridge-type TW coplanar waveguide (CPW) EAM are performed for overcoming bandwidth limitation factors.

NUMERICAL RESULTS

Important design issues of EAM are to increase the bandwidth and reduce the drive voltage. We demonstrate microwave indicies with variation of several structure parameters. To increase microwave phase velocity, we may consider several design of structures. Because microwave index mainly affected by capacitance C and inductance L, the width and thickness of waveguide can adjust capacitance and inductance to decrease microwave index. Fig. 1 and Fig 2 display how the microwave index changes with waveguide thickness and width. The microwave index of ridge-type CPW increase as the distance between signal and ground eletrode decrease in Fig. 3.

CONCLUSION

Since the ridge-type CPW has more of less complex structure, numerical method more appropriate than analytic method. In this paper the 3D FDTD method is used to perform the time-domain simulation of the ridge-type CPW EAM. We can consider various design to improve bandwidth of ridge-type TW CPW MQW EAM. The waveguide width and thickness affect the microwave phase velocity and also the distance between ground and signal electrode relate microwave index. Our simulation demonstrates that the perfect phase velocity matching between light-wave and microwave is difficult, but through the consideration of several design parameters, the bandwidth can be improved.

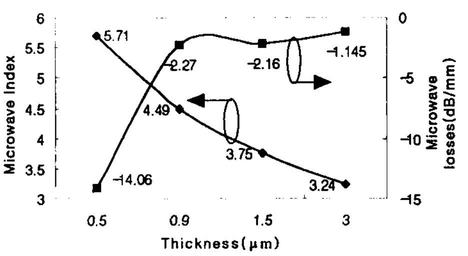

Fig. 1. Microwave Index with variation of active region of thickness

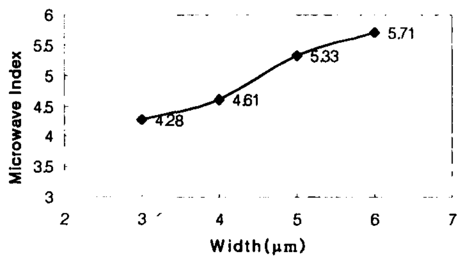

Fig. 2. Microwave index with variation of active region of width

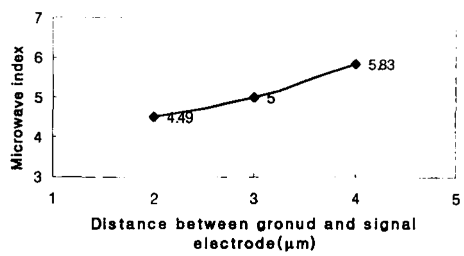

Fig. 3. Microwave index with variation of distance between signal and ground electrode.

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