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InP/InGaAs Partially p-Doped Photodiode with Leaky Optical Waveguide and Distributed Bragg Reflectors for High-Saturation-Current and High-Bandwidth-Responsivity Product

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Abstract

In this paper, we proposed a novel structure of PD to improve its saturation current [1] and bandwidth-responsivity product [1] performance. Figure 1 shows the cross-sectional view of the proposed photodiode. By integrating the evanescent-coupled optical waveguide [2] with partially p-type doped photo-absorption layer [3] and Distributed-Bragg-Reflectors (DBR) [4], such device can increase the absorption path without increasing the length of active region. The bandwidth-responsivity product performance of photodiode can thus be enhanced. Furthermore, a high saturation current of this novel device can also be expected due to the partially p-doped absorption layer. In order to primarily investigate the performance of p-doping in the photo-absorption layer, two kinds of devices (A and B) without DBR mirrors in the end of waveguide are fabricated. Figure 2 reveals that the partially p-doped photodiode (device A) has significant higher values of RF saturation power than the control photodiode (device B) without partially p-doped photo-absorption layer especially under low dc bias voltage. Figure 3 shows the simulated result of reflection-spectrum. The period of simulated DBR structure was about 245 nm and the simulated maximum reflection of the DBR structure could achieve 100%. The SEM photograph of fabricated DBR structure was shown in the figure 4. More detail measurement results of this novel device will be given in the conference.

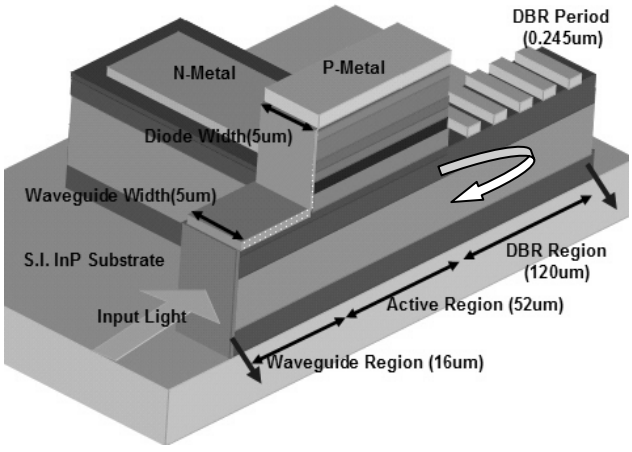

Fig 1. The cross-sectional view of the photodiode.

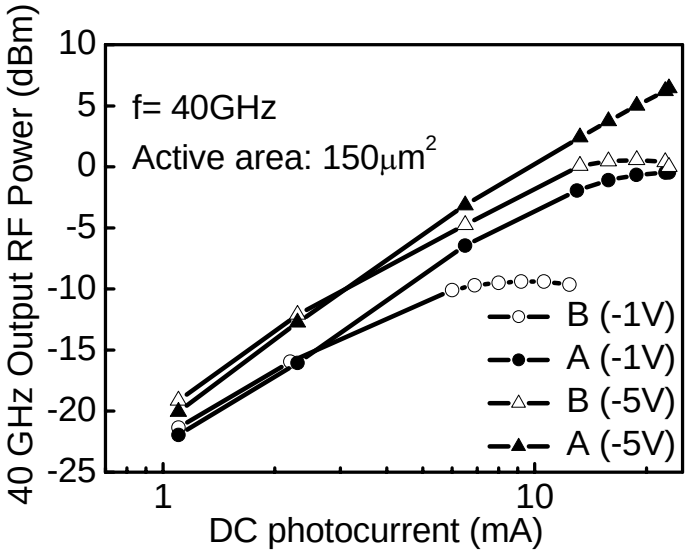

Fig 2. RF power versus dc photocurrent of device A and device B under different reverse bias voltages (close triangle: -5V of device A, open triangle: -5V of device B, close circle: -1V of device A, open circle: -1V of device B) at 40GHz operating frequency.

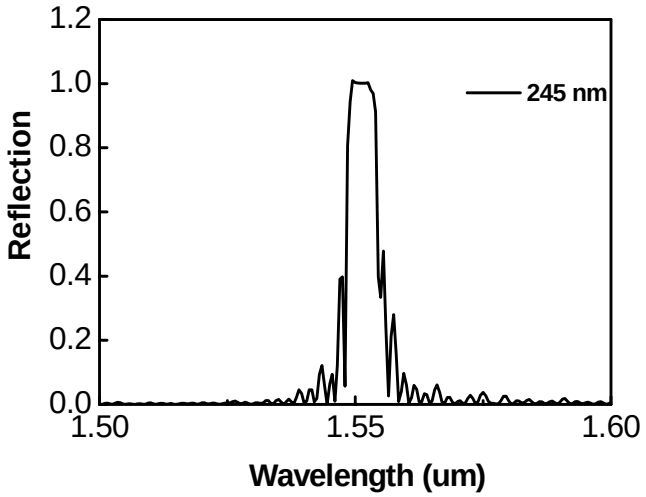

Fig 3. The simulation of the reflection for the DBR with period of 245 nm.

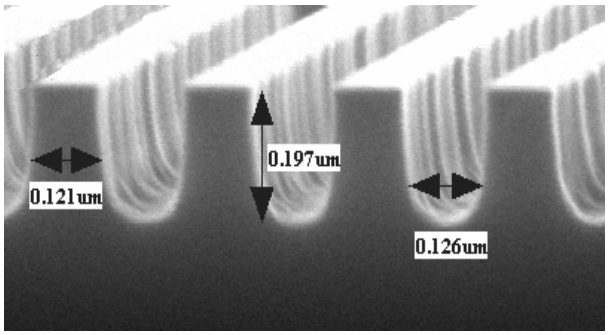

Fig 4. The SEM photograph of the DBR

Reference:

[1] K. Kato, IEEE Trans. Microwave Theory Tech., **47** (1999) 1265

[2] S. Demiguel and N. Li, *IEEE Photon. Technol. Lett.*, **15** (2003) 1761

[3] Y. S. Wu and J. W. Shi, *IEEE Photon. Technol. Lett.*, **17** (2005) 878

[4] P. V. Studenkov and F. Xia, *IEEE Photon. Technol. Lett.*, **12** (2000) 468