THz MSM TRAVELING-WAVE PHOTODETECTORS FOR COMMUNICATIONS AND IMAGING

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Abstract – *In this talk, we will review the design, fabrication, and performance of sub-terahertz bandwidth metal-semiconductor-metal traveling-wave photodetectors. Its application in THz bandwidth communication and T-ray imaging will be discussed.*

High speed photodetectors have been studied extensively in the past decade, owing to their applications in broadband optical communication network and optical generation of high power millimeter/THz waves [1]. In this presentation, we will review the design, fabrication, and performance of sub-terahertz bandwidth metal-semiconductor-metal traveling-wave photodetectors (MSM TWPD) [2]. By utilizing LTG-GaAs as the photo-absorption layer, the dominant propagation microwave mode in a MSM TWPD is "quasi-TEM mode". The characteristics of low loss and high velocity in the Quasi-TEM mode ensure much higher velocity-match bandwidth compared with that of the p-i-n based TWPD. The fabricated devices exhibit a high-speed performance at 800 nm, with a 0.8ps impulse current response and a 570GHz bandwidth [2]. This device also provides a record peak-output-voltage-bandwidth product performance (~30V, 190GHz, 5.7 THz-V) at 800nm [3] under high optical excitation. This is achieved by increasing the photo-absorption volume in a MSM TWPD. Our recently studies have also demonstrated the high speed and high power performances of the fabricated device at the telecommunication wavelength [4] by utilizing mid-gap defect state to conduction band absorption. With a 70μm-long absorption length, its transient impulse response and the corresponding bandwidth at telecommunication wavelength was 1.28 ps (4V bias) 234 GHz 3dB bandwidth [4]. A record peak-output-voltage-bandwidth product of 568 GHz-V was also obtained from the device for the telecommunication regime (160-GHz bandwidth, 3.55-V peak output voltage).

With such a high bandwidth high power performance, this MSM TWPD can not only be applied for high bandwidth telecommunication, but also as a compact source for efficient generation of THz radiation for molecular imaging and warfare detection. By combining the THz MSM TWPD with a THz antenna, we recently also demonstrated a THz photonic transmitter [1]. The ultrahigh external light-THz conversion efficiency (0.11% @ 645 GHz , 0.02% at 1.6THz) and the edge-coupled structure of our demonstrated devices imply their applications as compact optoelectronic based THz radiators. Some preliminary results on the CW T-ray imaging system will be discussed.

REFERENCES

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