The 8th International Conference on Optical Terahertz Science and Technology, paper 102, Tu-P-23, USA, (2019)

Signal Transmission Using Long Solid Core Terahertz Waveguide

Kathirvel Nallappan[1,2], Hichem Guerboukha[2], Yang Cao[2], Chahe Nerguizian[1], Maksim Skorobogatiy[2]

[1]*Department of Electrical Engineering, Polytechnique Montréal, Québec, Canada*
[2]*Department of Engineering Physics, Polytechnique Montréal, Québec, Canada*

Terahertz (THz) communications is being studied extensively to meet the bandwidth demand in high-speed wireless signal transmission. So far, THz communications have been mainly demonstrated in free space wireless links due to the presence of several atmospheric transmission windows. In free space links, bulk optical components are necessary to collimate and focus the THz beam at the transmitter and receiver respectively. Particularly, the THz wireless links are very sensitive to alignment errors which requires careful positioning of the antenna. Furthermore, it is difficult to integrate the THz wireless communication system with other sub-components/devices for signal processing applications. Therefore, a low loss THz waveguide is preferred. The choice of waveguide material is one of the major obstacles in achieving THz guidance with low loss and dispersion [1]. By selecting proper materials (Teflon, polyethylene, cyclic olefin copolymer to name a few) and engineering the waveguide structure, a highly efficient THz guidance can be achieved. THz fibers with subwavelength dimension offers low loss when compared with the bulk material where most part of the modal field propagates in air from which efficient THz components such as directional coupler, power divider, band pass filter etc. can be realized for real-time signal processing applications.

In this work, we study in detail and demonstrate the real-time data transmission using a long solid core polypropylene waveguide (1.75 mm diameter). A photonics-based THz communication system operating at the carrier frequency of 140 GHz is used to characterize the waveguide. The waveguide is butt coupled in both emitter and detector antenna to minimize the free space coupling loss. The performance of the fiber is measured by recording the bit error rate (BER) for the transmitted data rate of 5 Gbps. By fixing the decision threshold to 0 mV, the BER of 10^{-7} is recorded for the fiber length of 3 m and 5 m respectively. A successful error free data transmission using a 1 m fiber with the diameter of 670 µm is also demonstrated.

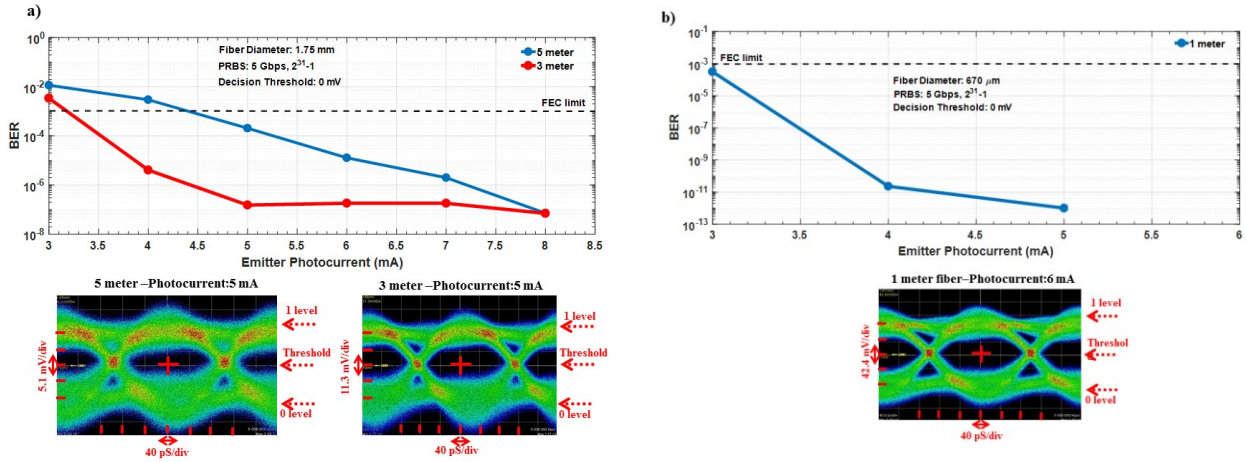

Fig. 1 Measured BER as a function of the THz emitter photocurrent for a) 3 m and 5 m, 1.75 mm polypropylene waveguide b). 1m, 670 µm polypropylene waveguide

References

[1] S. Rana, A. S. Rakin, H. Subbaraman, R. Leonhardt, and D. Abbott, "Low loss and low dispersion fiber for transmission applications in the terahertz regime," *IEEE Photonics Technology Letters,* vol. 29, no. 10, pp. 830-833, 2017.