560GHz-Band Terahertz Wireless Communication Using Microcomb-driven Terahertz Wave and Heterodyne Detection

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Terahertz (THz) wave is expected to be utilized as wireless carrier waves in next-generation mobile communication systems (6G). The realization of ultra-high-speed and high-capacity communication in 6G necessitates low phase noise for THz carrier waves. Photomixing of near-infrared optical beat signals with a uni-travelling carrier photodiode (UTC-PD) is a promising method to generate THz waves. By employing a micro-cavity optical comb (comb mode spacing, 560 GHz) for near-infrared optical beat signals, ultralow phase noise characteristics can be achieved in THz waves, surpassing those of electrical THz generation methods such as frequency multiplication. In our previous work, we generated THz waves at 560 GHz via the photomixing of a 560GHz-spacing micro-cavity comb and demonstrated wireless data transmission at a rate of 1 GBaud using modulation formats of On-Off Keying (OOK), as well as Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), and 16 Quadrature Amplitude Modulation (16QAM) with square-law detection using a Schottky Barrier Diode (SBD).

In the present study, we have replaced the THz receiver from SBD to a sub-harmonic mixer (SHM) for the implementation of sensitive heterodyne detection in THz wireless communication at 560 GHz. Along with the introduction of an IQ modulator, we successfully demonstrated high-speed data transmission at 42 Gbaud (84 Gbps) using QPSK and achieved the forward error correction (FEC) limit. Additionally, we realized data transmission at 25 Gbaud (100 Gbps) using 16QAM, also meeting the FEC limit. These results highlight the potential of micro-cavity comb-based THz wave generation for ultra-high-speed wireless communication in the 560 GHz band.

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