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Title

Tunable, continuous-wave Terahertz photomixer sources and applications

Source

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Abstract

This review is focused on the latest developments in continuous-wave (CW) photomixing for Terahertz (THz) generation. The first part of the paper explains the limiting factors for operation at high frequencies ~ 1 THz, namely transit time or lifetime roll-off, antenna (R)-device (C) RC roll-off, current screening and blocking, and heat dissipation. We will present various realizations of both photoconductive and p-i-n diode-based photomixers to overcome these limitations, including perspectives on novel materials for high-power photomixers operating at telecom wavelengths (1550 nm). In addition to the classical approach of feeding current originating from a small semiconductor photomixer device to an antenna (antenna-based emitter, AE), an antennaless approach in which the active area itself radiates (large area emitter, LAE) is discussed in detail. Although we focus on CW photomixing, we briefly discuss recent results for LAEs under pulsed conditions. Record power levels of 1.5 mW average power and conversion efficiencies as high as 2×10^{-3} have been reached, about 2 orders of magnitude higher than those obtained with CW antenna-based emitters. The second part of the paper is devoted to applications for CW photomixers. We begin with a discussion of the development of novel THz optics. Special attention is paid to experiments exploiting the long coherence length of CW photomixers for coherent emission and detection of THz arrays. The long coherence length comes with an unprecedented narrow linewidth. This is of particular interest for spectroscopic applications, the field in which THz research has perhaps the highest impact. We point out that CW spectroscopy systems may potentially be more compact, cheaper, and more accurate than conventional pulsed systems. These features are attributed to telecom-wavelength compatibility, to excellent frequency resolution, and to their huge spectral density. The paper concludes with prototype experiments of THz wireless LAN applications. For future telecommunication systems, the limited bandwidth of photodiodes is inadequate for further upshifting carrier frequencies. This, however, will soon be required for increased data throughput. The implementation of telecom-wavelength compatible photomixing diodes for down-conversion of an optical carrier signal to a (sub-)THz RF signal will be required. (203 References).