4-QAM 100 Mbps wireless transmission at 20 GHz carrier frequency enabled by a graphene optoelectronic mixer

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We report on a wireless transmission of a 4-QAM 100Mbps sequence at 20 GHz carrier frequency, implemented using a graphene optoelectronic device at the transmitter stage. The proposed scheme promises very high wireless transfer rates using mm-wave carrier frequency which can be easily generated by optical beating in the device itself

Keywords: graphene, optoelectronic mixer, wireless transmission, microwave photonics, silicon photonics

Graphene is a promising material in the field of photonics and optoelectronics. For this reason, it has been widely studied in the last years, especially as an enabling material for the next generations of optical communication systems [1]. The interest on graphene is due to several properties, such as optical absorption at telecom wavelengths, very high carrier mobility and short photocarrier lifetime [2-4]. Moreover, this material is compatible with the standard silicon fabrication processes. The basic building blocks of optical communication systems, such as modulators and detectors, have been already implemented with graphene on integrated photonic chips [5-6]. The reported performances of such devices show the high potential of graphene. Nevertheless, beyond the demonstration of the single device, the number of system implementations exploiting graphene as active material is very limited.

In this work, we show a complete wireless transmission scheme based on graphene at the transmitter stage. In particular, we use a graphene-based optoelectronic mixer (OEM) [7-8] designed by us, integrated in a Silicon Photonic chip. To fabricate the device, we used high quality single graphene crystals obtained using a chemical vapour deposition technique (CVD). Then, we transferred the graphene crystal on the photonic waveguides using a semi-dry transfer process, which insures no damage of the material[10]. The obtained device is a high-frequency photoconductor exploiting the photo-bolometric effect [9]. Since the responsivity of the device depends linearly on the applied voltage, it can act as a mixer between an electrical signal directly applied to its electrodes and a detected optical signal. Moreover, due to its fast response, this optoelectronic mixer (OEM) can mix signals in the GHz range. This has enabled the transmission of a 100 Mbps four-level QAM signal through a complete wireless link, using a 20 GHz carrier frequency. This last has been generated by the optical beating of two laser tones directly applied to the device itself. We also present a complete RF characterization of the graphene-based device, which reveals very high potential in terms speed. Indeed, the operating bandwidth exceeds 50 GHz, far beyond the reported system demonstration, only limited by the available experimental equipment. This result paves the way to mm-wave optically-enabled wireless links for next generation communication systems.

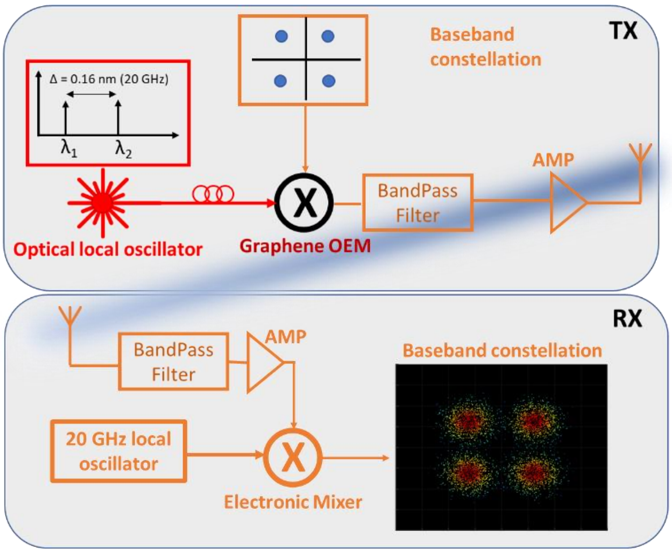

Fig. 1 Wireless communication scheme enabled by a graphene optoelectronic mixer at the transmitter stage

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