Optically enabled wireless transmission based on a graphene photo-conductor

Alberto Montanaro[1]
S. Marconi[1,2], M. Midrio[3], M. A. Giambra[1], V. Mišeikis[4], M. Artiglia[1], V. Sorianello[1], F. Scotti[1], A. D'Errico[5], C. Coletti[4], M. Romagnoli[1]

1. Photonic Networks and Technologies Lab – CNIT, Via G. Moruzzi 1, 56124 Pisa, Italy
2. Tecip Institute – Scuola Superiore Sant'Anna, Via G. Moruzzi 1, 56124 Pisa, Italy
3. Consorzio Nazionale per le Telecomunicazioni (CNIT), University of Udine, Via delle Scienze 206, 33100 Udine, Italy
4. Graphene Labs, Istituto Italiano di Tecnologia, Via Morego 30, 16163 Genoa, Italy
5. Ericsson Research, Via G. Moruzzi 1, 56124 Pisa, Italy
amontanaro@cnit.it

Due to its broadband optical absorption [1] (including telecom wavelengths), high carrier mobility [2] and short photocarrier lifetime [3], graphene is particularly suited as an active material for high-frequency opto-electronic applications. Moreover, graphene can be easily integrated in a standard silicon-photonics platform [4]. Thanks to the possibility of modulating their photo-responsivity, graphene-based photo-detectors can be used as optoelectronic mixers (OEMs) [5].
Here we report on the demonstration of an optically enabled wireless link using a graphene-based optoelectronic mixer (gOEM) (Fig. 1), fabricated by us, at the transmitter stage. A pattern generator (PG) was used to generate a 20 Mbit/s pseudo-random binary sequence (PRBS), up-converted through the gOEM around an optically generated 9.7 GHz carrier frequency. The signal was fed to an antenna and transmitted to a RF receiver (Fig. 2). At the receiver, the sequence was down-converted and the eye diagram was measured through a real time oscilloscope (Inset of Fig. 2). The photodetector bandwidth exceeding 50 GHz indicates the potential of gOEMs for wireless transmissions well beyond the performance presented in this demonstration, limited by the available equipment. This result opens the possibility of using graphene as an active material for the next generation wireless communications.

References

[1] R. R. Nair *et al.*, Science 320, (2008) 1308
[2] D. G. Purdie *et al.*, Nat. Commun. 9, (2018) 5387
[3] M. Lazzeri *et al.* Phys. Rev. B 78 (2008) 081406
[4] M. Romagnoli *et al.*, Nat. Rev. Mater. 3 (2018) 392–414
[5] A. Montanaro *et al.*, Nanoletters 16 (2016) 2988.

Figures

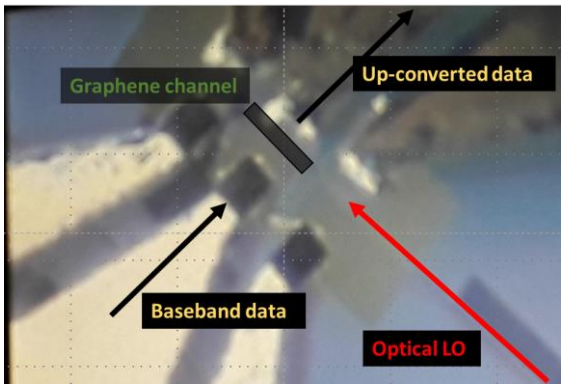

Figure 1: Photo of the gOEM used to up-converd the baseband datastream

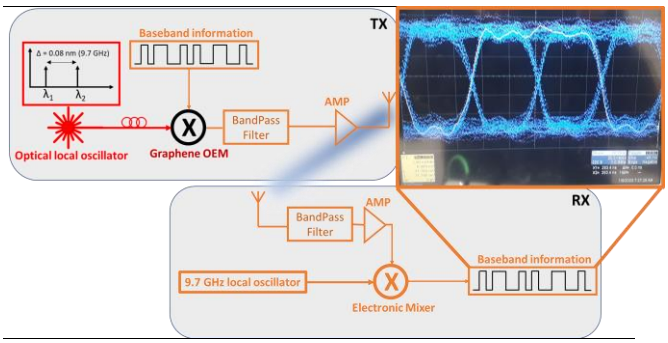

Figure 2: Experimental set-up of the optically-enabled graphene-based wireless link. In the inset on the right, the 20 Mbit/s Eye diagram of the received PRBS transmitted by the gOEM