High-Speed Optoelectronic Sampling at 1.55 µm with High-mobility Graphene

POMMIER Delphine
E. Grimaldi, D. Pommier, L. Hamidouche, P. Berger, S. Combrie, G. Baili, P. Legagneux (1), M. Tharrault, M. Rostischer, B. Plaçais, E. Baudin (2), T. Taniguchi, K. Watanabe (3)
(1) Thales Research & Technology, 91767 Palaiseau, France
(2) Laboratoire de Physique de l'Ecole normale supérieure, ENS, Université PSL, CNRS, Sorbonne Université, 75005 Paris, France
(3) Advanced Materials Laboratory, National Institute for Materials Science, Tsukuba, Ibaraki 305-0047, Japan
Contact : Delphine.pommier@thalesgroup.com

In communication systems, radiofrequency (RF) signals are carried by a high carrier frequency. Thus, before being digitalized, the signal is first down converted to baseband using an electronic or optoelectronic sampler. However, all-electronic samplers are limited due to narrow bandwidth, nonlinearities and jitter noise that are introduced by electrical clocks [1,2], as opposed to optoelectronic samplers, with ultra-stable optical pulse trains having extremely low phase noise and jitter (generated by active mode-locked lasers). We show in this presentation improvement over state-of-the-art optoelectronic sampling at 1.55 µm using high mobility graphene (see fig.1), featuring a conversion efficiency similar to the most performant samplers (GaAs, working at 0.8 µm [3]) over a 40 GHz bandwidth with harmonic rejection below –43 dB at 20 GHz. We also show a comprehension of the harmonic rejection origin in graphene, leading to a methodology to optimize device performances.

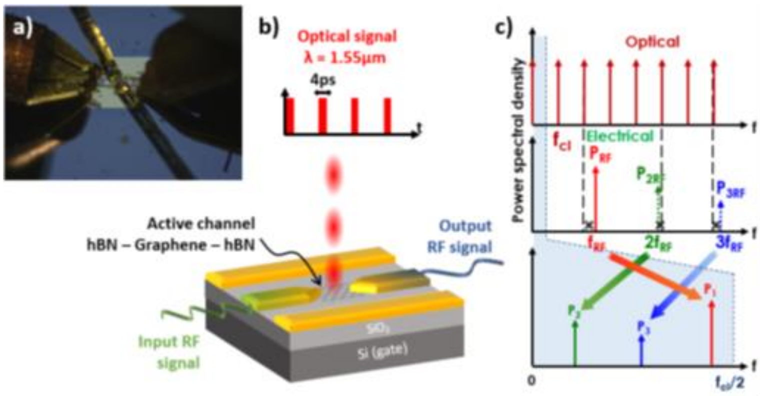

Figure 1: a) Picture of the graphene-based optoelectronic sampler. **b)** Experimental scheme: a 1.55 µm lensed fiber fed by a mode-locked laser illuminates the graphene channel embedded in a coplanar waveguide. RF probes allow both the injection of the high-frequency RF input signal along with DC channel biasing, and the measurement of the down-converted output RF signal. A Si backgate controls the graphene doping. **c)** Principle of subsampling : the optical clock signal (top panel) is mixed with the input RF signal (middle panel), generating down harmonics in baseband (bottom panel, light blue area).

References

[1] R. H. Walden. 1999, IEEE Journal on selected areas in communications, pp. 17, 4 539
[2] A. Khilo, S. J. Spector, M. E. Grein, A. H. Nejadmalayeri, C. W. Holzwarth, M. Y. Sander, M. S.Dahlem, M. Y. Peng, M. W. Geis, N. A. DiLello, et al. 2012, Optics Express, pp. 20, 4 4454.
[3] C. Tripon-Canseliet, M. Zegaoui, G. Jestin, C. Coinon, P. Berger, G. Baili, A. Descamps-Mandine, I. Maksimovic, D. Decoster, J. Hod´e, et al., Electronics Letters 2016, 52, 3 237.