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

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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


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