Graphene integration for CMOS multiplexed bioassays

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Graphene is now strongly emerging from the research phase towards industrial applications also in the microelectronics field, including photonics, sensing and electronics. The largest bottleneck in this process has been the scalability and reliability of the graphene fabrication and integration with the microelectronics process flows, in which respect the recent years have provided significant progress.

Most of the applications pioneering the industrialization are related to sensing, driven by the clear benefits of the high electrical responsivity of graphene and the relatively relaxed demands on the graphene quality, especially in terms of charge carrier mobility, with $\mu < 3000$ cm2/Vs already being adequate for most sensing applications. Here the biggest remaining challenges relate to the functionalization and readout strategies, and into the reliability and reproducibility of both the functionalization and graphene properties.

CMOS integration of the graphene sensors provide keys to address all these challenges, and is also the requirement for truly quantitative on-chip bioanalysis by providing the multiplexing for bioassays. In biosensing, the high sensitivity of the graphene transducers is combined with bioreceptors to provide a response specific to the desired bioanalytes, and the quantitativity generally requires both statistics and carefully selected set of receptors for internal calibration and referencing.

I will address our recent progress towards the fabrication of monolithically integrated graphene biosensor assays, from the graphene device fabrication on CMOS to array performance in liquid phase analysis, and give an overview of the future challenges.