CMOS integration of graphene for sensor applications

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The development of graphene field-effect transistor based biosensing has been fast during the last few years, both in terms of the fabrication scale-up and functionalization towards biorecognition from real sample matrices. The next steps in the industrialization relate to reliability and require increased statistics. In the fabrication, the device-to-device, and batch-to-batch variability need to be addressed, considering especially the stability, doping and contact resistance of the devices. In the functionalization and referencing towards truly quantitative sensors and on-chip bioassays, the improved statistics requires sensor arrays with controlled variability on functionalization. Such multiplexed bioassays, whether based on graphene or on other sensitive nanomaterials, are among the most promising technologies for label-free electrical biosensing.
As one important step towards that, we report wafer-scale fabrication of CMOS integrated graphene FET arrays with high yield and uniformity, designed especially for biosensing applications. We demonstrate the operation of the sensing platform with 512 GFETs in simultaneous detection for sodium chloride salt concentration series. This platform offers a truly statistical approach on graphene FET based biosensing and further on quantitative and multi-analyte sensing and can also be applied on other fields relying on functionalized FETs, such as gas or chemical sensing or IR detection.

Figures

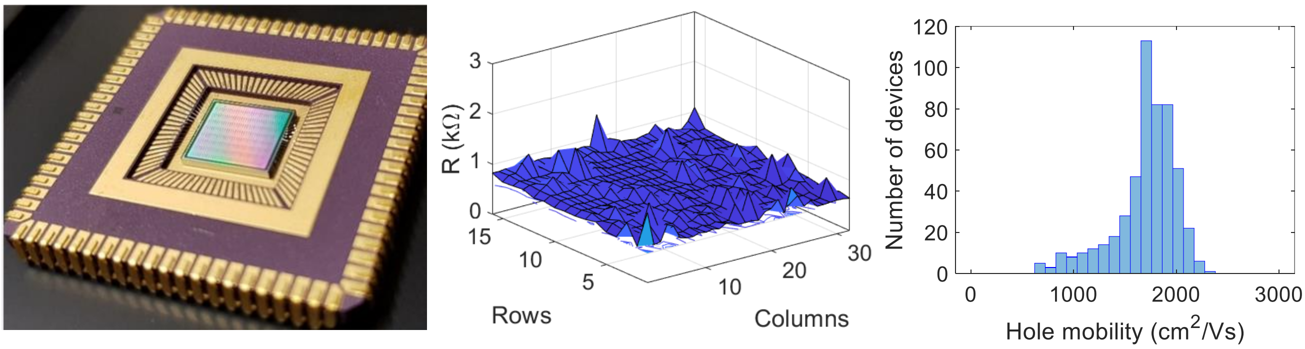

Figure 1: (Left) CMOS-integrated biosensor chip wire bonded on the chip carrier; (Middle) Resistance map of biosensor pixels on one chip with zero bias (Right) Histogram of hole mobility measured from an array of 512 graphene biosensors on a single silicon CMOS chip.