Graphene-Quantum Dot Photodetectors with Low Dark Current Readout

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Graphene-based photodetectors have shown responsivities up to 10^8 A/W and photoconductive gains up to 10^8 electrons per photon [1, 2]. These photodetectors rely on a photo-induced shift of the graphene chemical potential upon absorption, which modifies its channel resistance [3]. However, due to the semimetallic nature of graphene, the readout requires dark currents of hundreds of microamperes up to milliamperes, leading to high power consumption needed for the device operation [1-4]. In this work, we propose a different approach for highly responsive graphene-based photodetectors with orders of magnitude lower dark-current levels. A shift of the graphene chemical potential caused by light absorption in a layer of colloidal quantum dots induces a variation of the current flowing across a metal–insulator–graphene diode structure. This readout requires dark currents of hundreds of nanoamperes up to a few microamperes, orders of magnitude lower than that of other graphene-based photodetectors, while keeping responsivities of ~70 A/W in the infrared, almost 2 orders of magnitude higher than that of established germanium on silicon and indium gallium arsenide infrared photodetectors. This makes the device appealing for applications where high responsivity and low power consumption are required.

References

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Figures

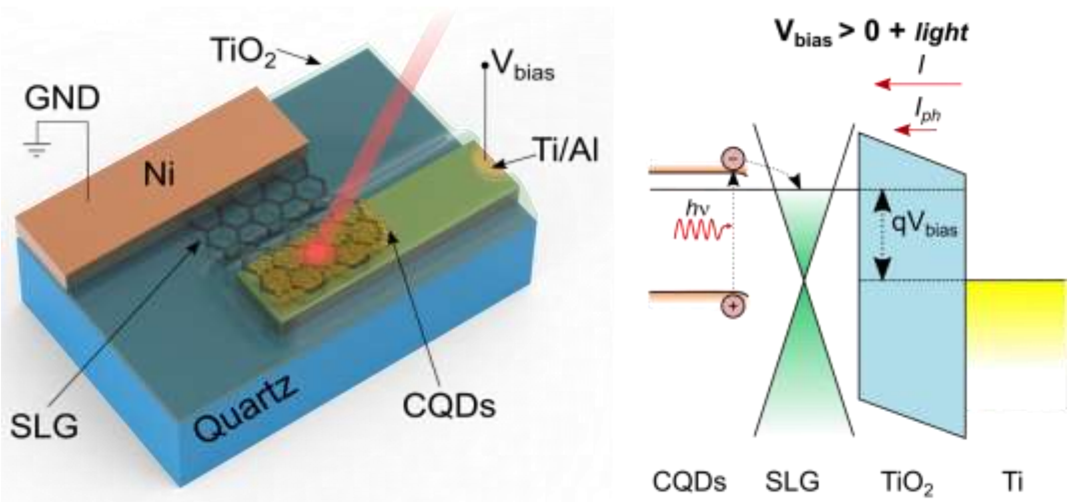

Figure 1: Schematic concept (left) and working principle (right) of the Graphene-Quantum Dot photodetector with low-dark current readout