Gate tunable colloidal nanocrystal-based infrared sensor

Tung Huu Dang[@,$], Angela Vasanelli[@], Yanko Todorov[@], Carlo Sirtori[@], Emmanuel Lhuillier[$]

[@] Laboratoire de physique de l'Ecole Normale Supérieure, ENS, Université PSL, CNRS, Sorbonne Université, Université de Paris, 75005 Paris, France

[$] Sorbonne Université, CNRS, Institut des NanoSciences de Paris, INSP, 75005 Paris, France.

Corresponding author: tung.dang-huu@phys.ens.fr

Photodetectors based on solution-processed active materials, such as colloidal nanocrystals (NCs), have emerged as promising candidates for the next generation of infrared sensing devices. However, these materials suffer from weak light absorption efficiency and poor electrical conductivity due to hopping transport. Here, we integrate HgTe NCs into plasmonic resonators and exploit spoof surface plasmon to enhance NC film absorption in the mid-wave infrared. We show that coupling the plasmonic resonator with the NC film improves the device's performance effectively, with a specific detectivity reaching $8x10^9$ Jones at 80 K, while the responsivity is 0.25 A/W at 200 K. Moreover, the device configuration allows us to tune the carrier density by simply applying a gate bias, which leads to an increase of the photocurrent to dark current ratio up to a factor of 20.

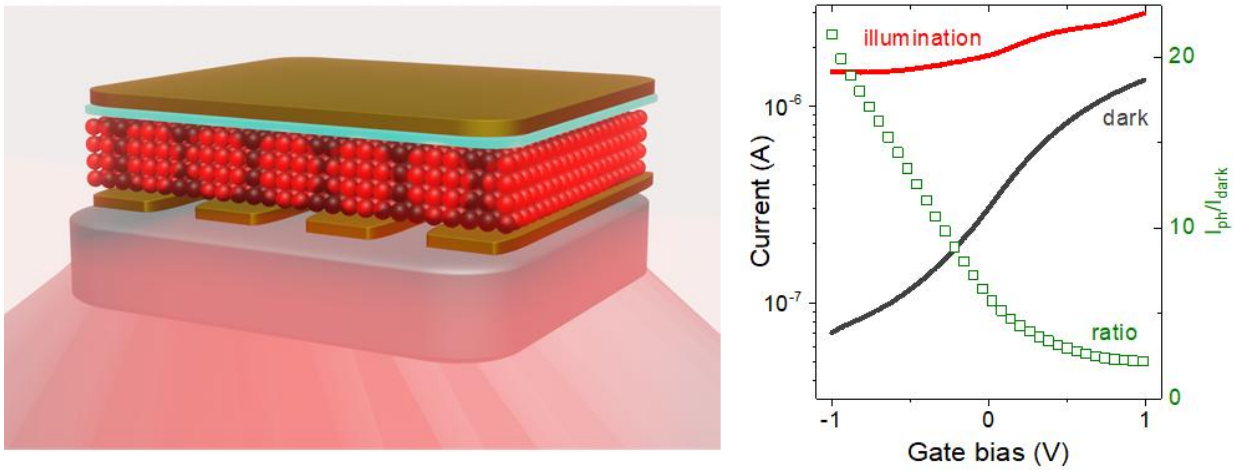

Fig. 1: Left: Scheme of the nanocrystal-based device coupled to a plasmonic cavity. Right: Current in dark conditions (black line) and under illumination (red line) as a function of gate bias. Green symbols present the ratio between the current under illumination and the dark current (right scale).

References:

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