Pyrene butyric acid functionalized PbS QDs for enhanced charge collection in hybrid graphene based NIR photodetector

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Photodetectors base on hybrid structures formed of graphene (G) and colloidal semiconducting quantum dots (QDs) have recently arisen interest for their very high responsivity, since they are able to combine the excellent conductivity of G [1], with the unique size-dependent light harvesting properties of QDs [2]. Limitations in the performance of such devices are due to a weak electron coupling at the G/QDs junction, along with the short Diffusion Length (DL) of minority carriers (ca. 250 nm) and low conductivity of QDs films [3]. We recently have demonstrated the effective light-energy conversion in hybrid nanocomposites based on pyrene butyric acid (PBA)-coated PbS QDs, immobilized onto CVD monolayer G, thanks to the electron coupling between the components provided by the pyrene linker [4]. Here, we report on hybrid photodetectors based on films of PBA-coated PbS QDs, spin-coated onto CVD monolayer G, and then treated with the short tetrabutylammonium iodide (TBAI) typically used in QD optoelectronic devices as ligand for the QDs ligand in order to improve the efficiency of photocarriers transport along the QDs [2]. Photoconductance investigation confirms that the use of PBA, concomitantly able to coordinate at the surface of QDs and bind them to G, and the treatment with TBAI result in superior performance over devices prepared by using TBAI both as ligand for the QDs and as linker at the G/QDs interphase.

References

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