EFFICIENT PHOTODETECTORS AT TELECOM WAVELENGTHS BASED ON THIN FILMS OF LEAD SULFIDE QUANTUM DOTS

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Colloidal QDs have recently attracted significant attention as promising candidate materials for many optoelectronic applications, including photodetectors, light-emitting devices and photovoltaics among others [1]. Moreover, these QDs are chemically synthesized from organometallic precursors and retain a passivating layer of ligands that make them solution processable. This is a very attractive technology for low cost and industrial scale up fabrication of those electronic devices on practically any kind of substrate (transparent plastics, glass and Si, among others) provided the appropriate electrodes. In the most recent literature on PbS QD-solid Schotky heterostructure photodetectors we find external quantum efficiencies (EQE = Responsivity.hv/e) below 20 % at the wavelengths of the exciton absorption band (≈ 1000 nm) under negative bias [2], whereas more than 106 A/W was reported for a MOS photoconductive structure based on a PbS layer (60-80 nm thick) on graphene [3]. In the present work, we focused our research on the optimized synthesis of IR absorbing PbS QDs to develop efficient Schottky-heterostructure photodetectors in the IR region (1300 – 1700 nm) (Fig. 1). The QD-films are deposited onto glass/ITO/PEDOT substrates by using a Dr-blade coating technique. The resulting devices by using Ag as a top electrode yield responsivities in the range 0.15-0.45 A/W (Fig. 2).

References

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[3]. G. Konstantatos, M. Badioli, L. Gaudreau, J. Osmond, M. Berneche, F. Pelayo, F. Gatti, and F. H. L. Koppens, Nature Nanotechnology 7, 363 (2012).

Figures

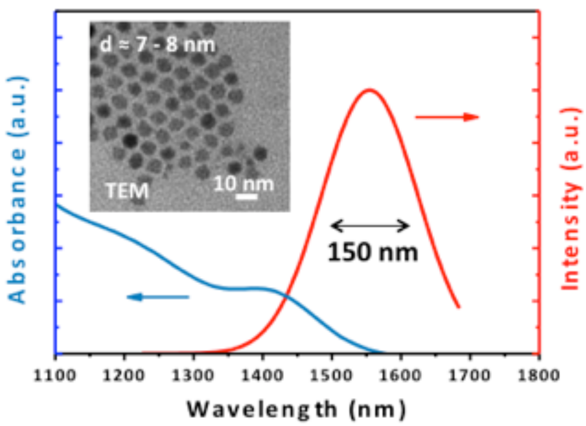

Fig. 1: Absorbance-Photoluminescence spectra of PbS colloidal QDs of 7-8 nm in diameter (see the TEM image as an inset),

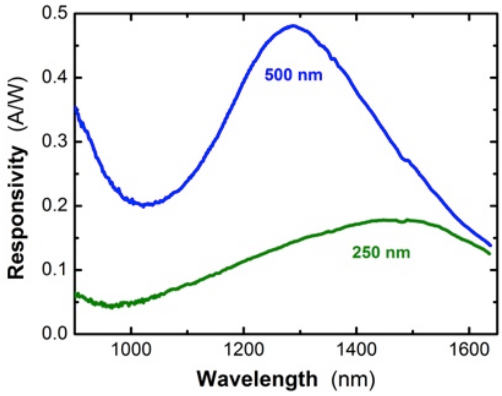

Fig. 2. Responsivity curves in photodetectors based on 250 and 500 nm thick PbS QD-solid films (their absorption edge lies beyond 1600 nm).