VISIBLE AND NEAR-INFRARED PHOTO-DETECTOR COMBINING POLYSILICON TFT AND PBS QUANTUM DOTS

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Integrated photodetector in the telecommunication range, around 1.4µm, is useful in new devices combining optics and electronics. It can be more useful if it can detect such wavelength with high detectivity and high speed.

Such photodetector was developed in this work using very simple process. It uses usual polysilicon TFT where PbS quantum dots (PbS-QDs) have been embedded in the gate insulator. PbS-QDs are mixed with SU8 photoresist and the mixed solution is deposited by spin-coating on the partially fabricated polysilicon TFT. After drying, the deposition forms a layer that is used as gate insulator in place of the usual SiO_2 layer. This TFT combine the high sensitivity of Quantum Dots (QDs) with the good charge transfer provided by the transistor's structure. The absorption spectrum of the present 5.58 nm diameter PbS-QDs shows a peak at 1350nm in the telecommunication range of wavelength. The photo-TFTs present a responsivity value of 13 A/W at this wavelength. The responsivity is 1800 A/W at 760nm. The detectivity values at IR wavelength can reach a very high value 1.0×10^{13} Jones for N-type TFT. The answer time to an optical pulse is only some tens ms.
The photo-transistor fabrication is compatible with all the present microelectronics technologies and with new flexible electronics technology. It can be directly implemented in any process without too much change. Particularly its process can be made in the last step after the fabrication of ICs.

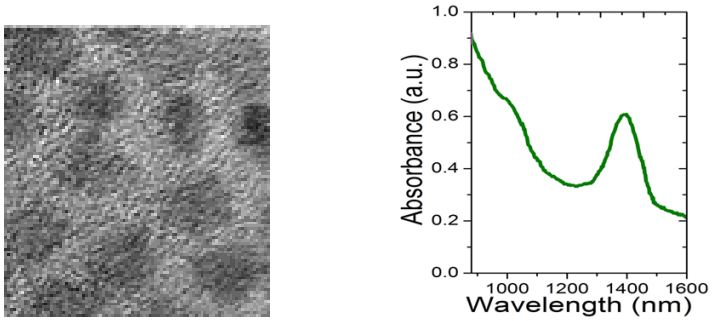

Figure 1: PbS quantum dots embedded in SU8 photoresist and their optical absorption showing an absorbance band at 1350nm.

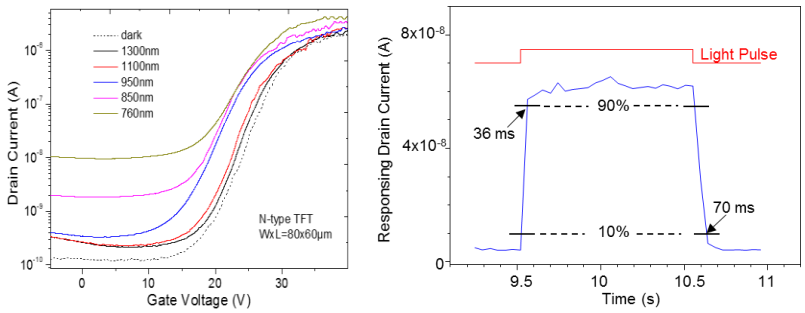

Figure 2: transfer characteristics of TFT under dark and under different wavelength and answer of the TFT to a light pulse