12th International Conference on Nanosciences & Nanotechnologies (NN15)
7-10 July 2015, Thessaloniki, Greece

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Optically Triggered Infrared Photodetector

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Abstract: We present and demonstrate experimentally a new kind of semiconductor device: the Optically Triggered Infrared Photodetector. This IR photodetector exhibits the following distinctive features: (1) It can be optically commuted ON and OFF by means of an external light bias, and (2) it does not require electrical power supply. The operation principle of the OTIP is as follows. External high-energy (higher than the semiconductor bandgap) light produces photocurrent in the device. Part of this current is lost as recombination through an intermediate band (IB) [1] within the bandgap of the semiconductor. The addition of IR light reduces such recombination and can be, therefore, measured as an increase in current. This new detector concept can be implemented by including quantum dots (QDs) in-between a p–n junction [2]. We demonstrate the operation of the OTIP in an InAs/AlGaAs QD-based device. Our experimental device shows response to normally incident light in the 2−6 μm range when externally biased by a 590-nm light emitting diode (LED). It also exhibits IR detection driven by a continuous range of photon energies above the bandgap of the device. Furthermore, we demonstrate an increase in detection gain with increasing light-bias intensity. For high intensities the photo-detection seems to saturate. In our experiments, the increase in detection gain did not come with an increase in the measurement noise; hence, it can be understood as an increase in the detectivity. The novel features of the OTIP opens up possibilities for new device applications, for instance, in optical communications.

[1] A. Luque, and A. Martí, Physical Review Letters **78**, 5014 (1997).
[2] I. Ramiro *et al.*, Nano letters (2014).