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“Understanding the intermediate band solar cell operation”

The Intermediate Band Solar Cell[1] is formed by sandwiching an Intermediate Band (IB) material between two ordinary semiconductors p- and n-doped. The IB material has an energy band or set of levels (the IB) situated within the bandgap of a semiconductor. In this way, besides the photocurrent generation by photons with enough energy as to pump electrons from the valence band (VB) to the conduction band (CB) a second path of current appears with two photons of less energy that completes the pumping using the IB as stepping stone. The concept is very attractive because this cell is potentially able to increase the photocurrent without decreasing the photovoltage. In this way the detailed balance[1] top efficiency is 63% to compare to the 41% of a single bandgap solar cell.

IB materials can be formed with the confined states of Quantum Dots (QDs)[2] grown in a host semiconductor. In this case the device technology is rather developed. Most of the work so far has been done with Stranski-Krastanov InAs QDs in GaAs, grown by MBE[3]. IBSCs of 18% efficiency[4] have been presented, reasonable but below the expectations. IBSCs may be fabricated also on special alloys presenting an IB[5]. In this case the absorption is good but the device technology is not mastered and the efficiency is low.

All this will be discussed in this lecture. A recent revision can be found in reference[6].

- [1] A. Luque et al., *Physical Review Letters* **78**, 5014 (1997)
- [2] A. Martí, et al., in *Proc. 28th IEEE Photovoltaics Specialists Conference*, IEEE, New York, 940 (2000)
- [3] A. Luque, et al., *Journal of Applied Physics* **96**, 903 (2004)
- [4] S. A. Blokhin, et al., *Semiconductors* **43**, 514 (2009)
- [5] W. Wang, et al., *Applied Physics Letters* **95**, 011103 (2009)
- [6] A. Luque, et al., *Nature Photonics* **6**, 142 (2012)

The seminar will be transmitted by videoconference to all NANO Centers.

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