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Nanowire Field Effect Junction Diode

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Description

Nanowires are quasi one-dimensional materials with diameters of 1 to 100 nm with lengths varying from a few nano to hundreds of micro meters. The silicon nanowire field effect junction diode is a new semiconductor device that expands the possibilities for solar cells and related applications in photovoltaic devices. Current semiconductor junctions have fixed PN junctions that are only capable of producing direct current (DC) voltage from sunlight. This device produces alternating current (AC) voltage in two nearby gates, thereby forming a PN junction along an evenly doped (or un-doped) nanowire.

Problem Addressed

A dynamic PN junction occurs along a nanowire when electrical gates are oppositely biased. As sunlight illuminates the transparent substrate, the junction generates an open circuit voltage. Reversing the bias voltage reverses the polarity of the junction, generating an AC voltage proportional to the intensity of the sunlight. Multiple devices may be combined to produce commercially useful power. Large surface-volume ratios and low-cost self-assembly make this a cost competitive device. Another advantage of AC solar panel is that you could install only a few, rather than a full array, without the cost of an inverter. In short, this device provides an efficient way to integrate nanowires with field effect diode structure for optical-to-electric energy and signal conversion.

Advantages

- This technology can be used in memory devices, switches and variable transistors & can be used in future for portable computers and cellphones that can operate for days between charging sessions
- This nanowire field effect diode can be used for small voltage detector
- It adds AC output functionality to photovoltaic device which is usually limited to DC output
- Producing AC directly improves the conversion of sunlight by eliminating costly power losses associated with converting DC to AC

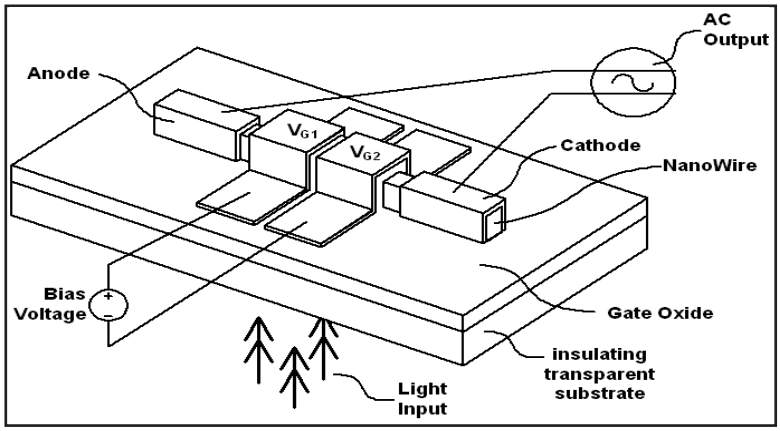

Figure One: Nanowire Field Effect Junction Diode

Recent Publications

- A. Z. Badwan, Z. Chbili, Y. Yang, A. A. Salman, Qiliang Li and D. Ioannou, "SOI field effect diode DRAM cell: Design and Operation" IEEE Elec. Dev. Lett. 34, 1002 (2013)
- D. Ioannou, Z. Chbili, A. Badwan, Qiliang Li, Y. Yang and A. Salman, "Physics and design of nanoscale field effect diodes for memory and ESD protection applications," Future Trends in Microelectronics: Frontiers and Innovations, 13-80, 2013
- Yang Yang ; Aveek Gangopadhyay ; Qiliang Li ; Dimitris E. Ioannou, "Scaling of the SOI field effect diode (FED) for memory application," 2009 International Semiconductor Device Research Symposium, DOI: 10.1109/ISDRS.2009.5378045

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