Plenary Session

HALL 1

T10-PL1: III-V nanowires: challenging nanostructures for high-efficiency solar cells

Paola Prete

Institute for Microelectronics and Microsystems (IMM), National Research Council (CNR), Lecce, Italy

Nanowires (NWs) based on III-V compound semiconductors possess great potentials for next generation energy conversion [1], light emitting devices with improved performance and reduced cost [2], and are an ideal platform for future quantum technology applications [3]. Free-standing III-V NW heterostructures are therefore attracting a steady research interest worldwide.

Photovoltaic solar cells (SCs) based on arrays of III-V compound NWs possess potentials for enormous improvement in solar power conversion efficiency. A strategy to achieve this goal is through improved light management of the incident sun light and multiband absorption. Three examples of these properties will be reported in this work.

Firstly, dense arrays of core-shell nanowires behave as super-absorptive media due to waveguiding effects: indeed, GaAs-AlGaAs core-shell NWs show strong enhancement of the near band-edge GaAs optical absorption, depending on the actual thickness of overgrown AlGaAs shells [4].

Secondly, insertion of a few nanometers thin GaAs shell in between two thicker AlGaAs barrier shells lead to the formation of a quantum well tube (QWT) within the NWs. In such nanostructures the carrier confinement within the GaAs well allows radial band gap engineering (tunable energy states) and increased light absorption over a wide energy spectrum [5].
Thirdly, adoption of an intermediate-band gap semiconductor (IBGS) as the active material of a III-V SC allows to combine the multiband absorption functionality of IBGS with advantages associated to nanowire-based SCs, avoiding complicated multi-junction architectures. The use of dilute nitrides (III-N-V) as IBGS within core-multishell NW-based SCs is a very promising solution, never reported so far. The challenges of self-assembling such NW SCs structures by MOVPE and their heteropitaxy on Si [6] will be discussed.

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