Simon Fafard, J Laser Opt Photonics 2017, 4:4 (Suppl)
DOI: 10.4172/2469-410X-C1-017

Laser power conversion efficiencies exceeding 60%, featuring strong photon recycling, in ultra-thin GaAs n/p junctions based on high-photovoltage vertical epitaxial heterostructure architectures

Simon Fafard
Université de Sherbrooke, Canada

Optical to electrical power converting semiconductor devices are achieved with breakthrough performance using a Vertical Epitaxial HeteroStructure Architecture (VEHSA design). The devices allow achieving a near-optimum responsivity, an improved photovoltage output compared to p/n junctions with standard thicknesses and low series resistance and shunting effects yielding high fill-factor values. The ultrahigh conversion efficiencies were obtained by monolithically integrating several thin GaAs photovoltaic junctions tailored with submicron absorption thicknesses and grown in a single crystal by epitaxy. Unique experimental evidence of the significant impact of photon recycling in these photovoltaic devices has been observed. The devices exhibited a near optimum responsivity of up to 0.645A/W for tuned excitation conditions or at high optical intensities for spectral detuning values of up to ~25 nm and corresponding to an external quantum efficiency of ~94%. These devices have now available as products manufactured by Broadcom and recent progresses will be covered, including: -The highest optical to electrical efficiency ever achieved; -The highest output powers ever reported for a high-efficiency monolithic PV cell with 5.87W of converted output from a CW laser; -The highest efficiencies ever reported for any types of optical to electrical power conversion devices simultaneously combining high photovoltage and output powers (> 5W at > 7V with > 60% efficiency and > 3W at > 14V with > 60% efficiency); -The highest efficiency ever reported of 61.8% with a significantly detuned optical input; -The highest photovoltage ever reported for monolithic photovoltaic semiconductor heterostructures with measured Voc > 23V; The thinnest p/n junctions ever implemented successfully with high-performance, with ultra-thin GaAs bases as small as 24 nm.

Biography

Simon Fafard was a Co-founder & President of Broadcom which is a large public company that recently acquired Azastra and has been an innovative Canadian opto-electronic company. He has been focused on optoelectronic at uSherbrooke and at Azastra, a corporation that commercialized laser power converter products based on the new VEHSA technology. He has an h-index of 45 and is the inventor of over 30 patents. He raised over $20M of private and venture capital funding and also obtained numerous research grants. He led Cyrium to become a manufacturer of one of the highest performance multijunction III-V solar cells and led Azastra to manufacture the highest performance phototransducer products. As an entrepreneur, he cumulates over 25 years of experience in Optoelectronics and Photonics while developing and commercializing numerous devices and products in the industry at Azastra, Aton, Cyrium, Alcatel Optronics, Kymata and also in research labs at uSherbrooke, NRC and UCSB.

simon.fafard@azastra.com

Notes: