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Jean-Luc Pelouard, J Nanomed Nanotechnol 2018, Volume 9
DOI: 10.4172/2157-7439-C6-081

2nd World Congress on

NANOSCIENCE AND NANOTECHNOLOGY

August 10-11, 2018 Osaka, Japan

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Revisiting SWIR photo-detectors: Improvements on both light-matter interaction and electron transport

The extreme light confinement provided by sub-wavelength metal-dielectric structures pushes towards revisiting the design rules of the photo-detectors. Furthermore, introducing absorbing layers in optical nano-resonators demands a dedicated electromagnetic design. Developing together semiconducting heterostructures and optical nano-antennas opens the way for performance improvements and new functionalities, introducing very promising features such as ultra-thin absorbing layers and device area much smaller than its optical cross-section. High responsivity, high-speed behavior and carved optical response are among the expected properties of this new generation of photo-detectors. In this talk, I present a GMR InGaAs photo-detector dedicated for imaging applications (FPA) as an illustration of this global design. Author will discuss the cross-linked properties of the optical and semiconductor structures. Experimental results show at λ=1.55 µm an External Quantum Efficiency (EQE) of 75% and a specific detectivity of 1013 cm.√Hz.W-1.

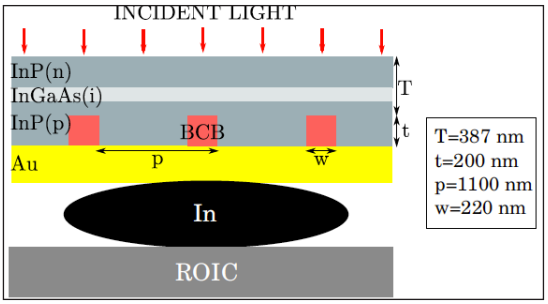

Figure-1: Cross-section of the InGaAs-based photo-detector connected to the read-out integrated circuit for imaging application.

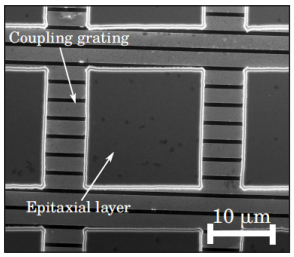

Figure-2: Top view of one pixel deposited on the nano-structured dielectric grating.

Recent Publications

1. Jean-Luc Pelouard, M Verdun et al., (2016) Dark current investigation in thin P-i-N InGaAs photodiodes for nano-resonators. *Journal of Applied Physics*; 120: 084501.
2. M Verdun, Jean-Luc Pelouard, et al., (2016) Guided-mode resonator for thin InGaAs P-i-N short-wave infrared photo-diode. *Applied Physics Letters*; 108: 053501.

Biography

Jean-Luc Pelouard has completed his PhD from Paris-Sud University at Orsay, France and Postdoctoral studies from NCSU at Raleigh, USA. Since 2000, he is the Director of Research at the National Center for Scientific Research. He is currently co-managing the common research laboratory MiNaO between CNRS and ONERA that is devoted to both fundamental and applied studies on infrared properties of sub-wavelength nanostructures. He has published more than 150 papers in reputed journals. He holds 15 international patents and has supervised 22 PhD theses.

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