Novel GaAs-Based, MBE-Grown Materials for THz Photoconductive Antenna Emitter Research at the University of the Philippines

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Abstract

We report on the continuing efforts of the National Institute of Physics, University of the Philippines, in the design, growth, and fabrication of novel structures for THz photoconductive antennas (PCA's) [1-3]. In particular, the talk presents recent works on the molecular beam epitaxial growth of gallium arsenide-based semiconductor trilayer films and modulation-doped heterostructures (MDH) as substrates for THz PCA emitter's [1,2]. The improvement of these novel substrates on the performance of the emitters are primarily attributed to the surface/interface electric field modification for the trilayer design; as well as an increase in the carrier mobility for the MDH design. Additionally, work is also being undertaken on the surface modification of the PCA's [3]. Initial results on the adsorption of Si nanowires on the PCA gap to improve THz generation will also be presented; as well recent work on the incorporation of micron-size metal line arrays on the emission side of the PCA. Being relatively large, these metal line arrays do not require electron beam lithography that are commonly employed in metamaterial enhanced PCA's. These research activities are carried out in collaboration with the FIR Center, University of Fukui, Japan.

Table 1. THz emission characteristics of novel PCA devices

PCA	Peak Amplitude [nA]	Bandwidth [THz]	Dynamic Range [dB]
Trilayer LT-GaAs*	17.8	3	50
MDH with recessed contacts*	30.9	3.2	60
SI-GaAs w/ SiNWs*	13.6	3	60
SI-GaAs w/ 2D MLA**	434	0.95	50

* Experiment Parameters: 9.5 mW pump, 32 Vpp bias, dipole PCA detector

** Experiment Parameters: 10 mW pump, 20 Vpp bias, spiral PCA detector

References:

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[3] N.I. Cabello et al., JSAP-OSA Joint Symposia 80, 19a-PA2-3, 18-21 Sept. 2019