POSTER SESSION

All-digital RF modulator for FM, PM and AM in a Magnetic Resonance Imaging (MRI) Transmitter

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This paper presents an all-digital RF modulator which enables FM, PM and AM in a Magnetic Resonance Imaging (MRI) transmitter. In the proposed digital modulator multi-band signal generation with less than 1 Hz inter-carrier frequency resolution and digital single side band modulation with 50 dB side band suppression are achieved.

A study of PET-DLA/ graphene Nanoplatelets Samples in the Range of 0-2 THz

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Graphene is one of the most popular and widely studied materials these days. Due to it unique electrical and optical properties it is a promising materials for next generation electronic, optoelectronic devices, and sensors. However, its properties in THz regime have not been understood well. Terahertz Time Domain Spectroscopy (THz -TDS) is a non-destructive tool to study the dielectric properties of materials with sub picosecond resolution. In this work PET-DLA/ graphene nanoplatelets samples in the range of 0-2 THz were studied. The absorption and transmission spectra of 300 μm thickness PET-DLA/ graphene nanoplatelets samples with different concentration of graphene were measured at room temperature. Absorption coefficient and refractive index dependence on sample composition were measured. Further research is going to be done with higher thickness of graphene samples to observe the graphene concentration effect more obviously.

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Graphene is currently one of the most widely studied materials, due to its unique electrical and mechanical properties and the promise of novel applications. One of the forms of graphene samples studied are polymer-graphene nanocomposites containing a controlled amount of exfoliated graphene. Nanocomposites used in this work were based on

poly(ethylene terephthalate-ethylene dilinoleate)(PET-DLA) matrix and were prepared in situ using a melt polymerization process, followed by hot-press technique. The resulting samples were thin (0.15 to 0.5 mm) polymer foils with the graphene content varying from 0.05% to 1%. THz radiation absorption and transmission spectra of our nanocomposites were obtained using a Terahertz Time-Domain Spectroscopy (THz-TDS) method. THz-TDS is a nondestructive tool to study complex dielectric functions of materials in the broadband (up to several THz) frequency range and is based on generation and detection of THz transients using femtosecond optical excitation. We collected a family of spectra in the 0–2 THz frequency range for PET-DLA/graphene composites with different concentration of graphene and compared them directly to the spectrum of a pure polymer reference sample. Subsequent numerical analysis of the collected data allowed us to extract the THz-frequency–range absorption coefficient and the complex refractive index and their dependences on the sample composition, i.e., graphene content. Our results shed new light on how incorporation of exfoliated graphene modifies polymer properties.

A study of reliability test program, critical testing processes and methods of analysis for Active Matrix OLED TV's

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Consumer electronics has a rapidly growing and developing structure all over the world. Especially, the TV industry has been completed its change at the beginning of 2000s and high-tech products have been replaced in the market. Advanced electronic display systems (mobile phone, TV, tablet) have been used back-lighting sources (fluorescent, DLP) until today. However recently, demands and requirements such as image quality, resolution, life time have been changed and these displays have begun not to meet the existing requirements longer. Since this has forced to develop new and innovative technologies, research and interests on LED technologies have been increased very rapidly for the last few years. In addition, intensive research on new generation of display technology has also been performed in order to increase the competitiveness of the companies.

Organic Light Emitting Diodes (OLED) display is a new generation of display technology to replace Liquid Crystal Display in near future because of their excellent advantages. The advantages of OLED displays can be listed as follows: self-illumination, lighter and thinner, high contrast ratio, high brightness, low power consumption, high efficiency, wide color

gamut and low reaction time. Due to these excellent properties, many OLED display based products can be found commercially available in the market.

Reliability is a probability that a device or system can fulfill its function under certain conditions within a specified period. The average life time of electronic devices are determined by calculation of Mean Time between Failure (MTBF) which is obtained by experimental test results under laboratory conditions. Reliability tests are performed in the laboratory using sophisticated test equipment. Reliability engineering requires the tests involved to comply with a plan to guarantee the production of valid scientific and statistical data. Therefore, reliability analysis and warranty time of electronic product is directly related to each other.

In this study, reliability test program, critical testing processes and methods of analysis has been identified for Active Matrix OLED TV. Design verification with data obtained from the components/ products based tests and analyzes of the average lifetime calculation were performed. Temperature analysis which is the most critical process that affect the performance and lifetime of OLED TV has been shown both theoretically / with a simulation and experimentally.

Atomic Layer Passivation of Type II InAs/GaSb superlattice photodetectors

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Passivation is still one of the important problem for the SL photodetectors. Uneven etch due to different etch rates creates undulation on the surface which cause voids in the passivation layer. Classical passivation methods: Dielectric passivation (SiOx, SiNx) Sulfurization ((NH4)2S, H2S) Organic materials (SU8, BCB, Polyimide), Wide band gap materials (AlGaAsSb).

METHOD: ALD is based on introduction of one atomic layer at a time, followed by adsorption and purge. ALD uses two gases that are introduced to the chamber one at a time and which react with the gas on the surface adsorbed during the previous sequence. ALD deposited Al2O3 has many advantages as a passivation layer such as the control of thickness at the molecular level since in the ALD process, thickness depends on the number of reaction cycles.

Electrical Performance of InAs/AlSb/GaSb Superlattice Photodetector

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Temperature dependent of dark current measurement is an efficient way to verify the quality of an infrared detector. Low dark current density values are needed for high performance detector applications. Identification of dominant current mechanism in each operating temperature with extracted their minority carrier lifetimes are highly important for understanding of carrier transport and improve the detector performance. Here we present electrical as well as optical performance of InAs/AlSb/GaSb based type-II SL N-structure photodiodes

Ferroelectric films as gate materials for low voltage operation of field effect transistors

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Control of the charge carrier distribution in a gated channel via a dielectric layer is currently the state of the art in design of integrated circuits such as the field effect transistors. Replacing linear dielectrics with ferroelectrics would ultimately lead to more energy efficient devices as well as the added advantage of the memory function of the gate. Here, we report that the channel-off/channel-on states in a metal/ferroelectric/semiconductor stack are actually transitions from a multi domain state to single domain state of the ferroelectric under bias. In our approach, there is no apriori assumption on the single- or multi- domain nature of the ferroelectric layer that is often neglected in works discussing the ferroelectric-gate effect on channel conductivity interfacing a ferroelectric. Without losing generality, semiconductor/ferroelectric/semiconductor stacks are also studied as each of the structures generate different boundary conditions on the ferroelectric layer. Our results show that the multidomain state is ultimately stable and that a switchable single domain state may not be necessary to achieve effective control of conductivity in a p-type channel. Results are presented in this manuscript also sheds light on experimental data in literature by explaining the underlying mechanisms for similar systems to control conductivity at ferroelectric/semiconductor interfaces in field effect transistors.

MBE Grown CdTe Absorber Layers on GaAs with In Assisted Thermal Deoxidation

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Molecular Beam Epitaxy (MBE) grown single crystal CdTe absorbers have great potential for highly efficient solar cell devices[1]. CdTe absorber layers are considered to be less affected from the structural defects then the III-V absorber layers[1]. Dominant covalent bond characteristic between the III-V atoms makes III-V absorber layers more vulnerable to the structural defects for solar cell applications[2]. Recently, efficiency of the polycrystalline CdTe based polycrystalline PV solar cell has reached 21.0 %[3]. However this value is still far from theoretical maximum. Polycrystalline CdTe based PV solar cells suffer from the poor crystal quality of the CdTe absorber layer which leads to low open circuit voltages (Voc)[1]. On the other hand, MBE grown CdTe absorber layers on GaAs substrates have potential to overcome structural defects related efficiency problems.

Thermal deoxidation of the GaAs wafers prior to the growth has important effect on the epitaxial grown layer. Ga2O3 desorption creates surface pits with 50 to 200 nm size and 5 to 40 nm depth on the GaAs surface which may reduce the interface and overall layer quality of the CdTe absorbers. In order to overcome this problem, we have employed In assisted thermal deoxidation at lower surface temperatures than the usual As assisted thermal deoxidation temperatures.

We have found that As assisted deoxidation creates larger and deeper pits on the surface with respect to the In assisted deoxidation. Also population of the pits related to the missing Ga atoms >50.5 nm on the GaAs surface were 15 % and 7 % in the As and In assisted cases, respectively. High Resolution X-ray Diffraction Rocking Curve of the CdTe(422) reflection is measured as 115 arc-seconds for 2.7±0.03 μm absorber layer.

1. Garland, J. W., Biegala, T., Carmody, M., Gilmore, C. & Sivananthan, S. Next-generation multijunction solar cells: The promise of II-VI materials. J. Appl. Phys. 109, 102425 (2011).

2. Çelebi, C., Arı, O. & Senger, R. Cleavage induced rows of missing atoms on ZnTe (110) surface. Phys. Rev. B 87, 85308 (2013).

3. NREL. http://www.nrel.gov/ncpv/images/efficiency_chart.jpg. (2014). at <http://www.nrel.gov/ncpv/images/efficiency_chart.jpg>

4. Li, L. H., Linfield, E. H., Sharma, R. & Davies, a. G. In-assisted desorption of native GaAs surface oxides. Appl. Phys. Lett. 99, 061910 (2011).

Noise Figure Study of a Narrowband LNA with Split Ring Resonator

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LNA (Low Noise Amplifier) structures are used for increasing the noise performance of a system in exchange for a decreased gain and high power consumption. In this study, a metamaterial based solution is aimed to decrease the noise figure of a low noise amplifier in MRI (Magnetic Resonance Imaging) frequency band. Depending on their geometries, SRRs (Split Ring Resonators) can have strong resonance characteristics such as a sharp dip (or peak) with a narrow bandwidth. Exploiting this property, different types of SRR structures were designed and simulated in CST Microwave Studio (MWS) and their S-parameters were experimentally recorded. The experimentally tested SRRs and the RLC networks mimicking their resonance behavior were cascaded with an LNA and simulated in ADS.

Without considering the resistive elements, the resonance behavior of any type of split ring resonator is roughly dependent on their inductance and capacitance values which, in turn, are dependent on the geometry of the structure. To lower the resonance frequency, the capacitance and/or the inductance of the device should be increased which is possible by increasing the device size in the simplest and the most direct way. The resonance characteristics of a ring resonator is strongly dependent on the geometry. Therefore, six different resonator geometries are designed and simulated in CST with different dimensions. The simulation results of NBSRR (Nonbianisotropic Split Ring Resonator) and DSR (Double Spiral Resonator) geometries showed better resonance behavior in MHz-frequency range.

NBSRR and DSR devices, placed in between a pair of strip antennas which represent a two-port network, were fabricated on a standard FR4 substrate with substrate thickness 1.59 mm (εr = 4.3) and copper thickness 35 μm. The devices are placed inside a Faraday cage and S11 and S21 parameters were measured. Measurements showed that S21 of NBSRR has a sharp dip around -46.149 dB at 383.4 MHz whereas for DSR structure S21 dip was measured to be -75.12dB at 214 MHz. The measured S-parameters were imported to ADS, and the noise figure performance simulations were compared to each other for various situations with different models.

N Structure Superlattice MWIR Photodetectors

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We introduce a unipolar barrier complex supercell superlattice system which increases electron-hole overlap under bias, significantly. Named as “N structure,” it is similar to a superlattice pin diode, but in contrast with the symmetrical M design, where AlSb is inserted in the middle of the GaSb layer, it has two monolayers (MLs) of AlSb inserted asymmetrically between InAs and GaSb layers, along the growth direction, as an electron barrier. It is well known that electron and hole wavefunctions shift under bias due to the tilting of the energy band diagram. In a symmetrical barrier design under bias, the electron-hole wavefunction overlap increases on one side of the barrier while it decreases on the other due to directionality of the electric field. In the case of an asymmetrical barrier placed with the direction of the bias field in mind, absorption increases without any loss of overlap. Despite the difficulty of perfect lattice matching of InAs and AlSb, such a design is expected to reduce dark current significantly, as in the M case.

Quantum Phase Slips in One-dimensional SQUID Chains

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We have carried out experiments on several long Josephson junction chains with junctions made up of Superconducting Quantum Interference Devices, SQUIDs, allowing for easy tuning of the Josephson coupling. We measured a finite zero bias resistance with a characteristic dependence on the Josephson energy, indicating that it is caused by Quantum Phase Slips, QPS. This dependence changes dramatically when the resistance exceeds the resistance quantum and the change is accompanied by a qualitative change in the nonlinear current-voltage characteristics which begin to show a signature of the Coulomb blockade [1].

The resistance of a SQUID chain can be described in terms of phase slips, sudden twists of the phase between neighboring junctions, giving rise to a voltage gradient along the chain. Phase slips are either thermally activated or induced by quantum tunneling. At low temperatures QPS dominate and they can be either coherent or incoherent. Incoherent QPS

cause dissipation whereas coherent QPS give rise to the Coulomb Blockade of Cooper pair tunneling and Bloch Oscillations in a Josephson junction, phenomena which are the electrodynamic dual to the DC and AC Josephson effects, respectively. Achieving phase-locking to Bloch oscillations in a circuit which can support a DC electrical current is of fundamental interest for a new quantum standard of current.

Superconducting Nanowires (SN) are widely used as single photon detectors and they have outperformed similar technologies. On the other hand a SQUID chain can emulate an ideal SN when the chain is long enough and uniform enough to hide its discrete nature. In this sense SQUID chains are artificial nanowires with great freedom of design. Therefore, SQUID chains have the potential for the development of photon counting applications for infrared wavelengths with high efficiency and low dark counts. We propose that the Superconducting nanowires made out of SQUIDs can be used not only for the optical communication but also for space applications, such as Superconducting Quantum Interference Device Single Photon Detectors (SQUID-SPD).

References

[1] A. Ergül et al., Localizing quantum phase slips in one-dimensional Josephson junction chains New J. of Phy., 15(9):095014 (2013)

Wave function overlap comparison between symmetric InAs/GaSb and asymmetric InAs/AlSb/GaSb type II superlattice photodetectors

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Wave function overlap of carriers are important issue in type-II SL photodetectors. Optical performance of T2SL depends on type-II transitions of photo-generated carriers at the superlattice interfaces.

Method: Known as 6.1A material family, InAs/AlSb/GaSb material system is highly desirable for designing high performance of new photodetectors in the MWIR. Material and thickness composition in a period affects electron-hole wave function overlap. Placing thin AlSb layer in between InAs and GaSb layers may act as a unipolar barrier which confines hole wave fuctions into GaSb layers. This results to increase in carriers overlaps at GaSb/InAs interfaces.