ABSTRACT&REFERENCES

PHYSICAL AND TECHNOLOGICAL PROBLEMS OF RADIO ENGINEERING DEVICES, TELECOMMUNICATION, NANO-AND MICROELECTRONICS

BIO/INORGANIC NANOHYBRIDS OF L-ASPARTIC ACID: OBTAINING, PROPERTIES, APPLICATIONS (p. 4-10)

Fedir Ivashchyshyn, Roman Shvets, Ivan Grygorchak, Anatoliy Kondyr, Andriy Kurepa

Using the developed technology, double-matrix structures of the hierarchical architecture GaSe <LAK> InSe <LAK> and C <LAK> were obtained. In the first two systems, significant increase in photosensitivity and visualization of the effect of photo-inductive response was recorded. New effect was revealed - oscillation of imaginary component of complex impedance of nanostructure GaSe<LAK> under lightning, which is most likely caused by the phenomenon of quantum-mechanical resonant tunneling. Also, this nanostructure is characterized by a high quality factor that is promising for its use in the manufacture of super-high capacity radio-frequency capacitors. Frequency dependence of dielectric permittivity of InSe <LAK> nanostructure is very interesting, namely its low-frequency oscillations, which may be caused by the processes of charge accumulation on the inter-phase limits and resonant tunneling in the N- barrier structure, formed as a result of nano-hybridization.

The use of the synthesized structure C <LAK> as cathode material for Li^+- intercalation current formation provided the value of specific capacity of 350 mAh/g, which is twice higher than the specific capacity of the known market cathode materials

Keywords: intercalation, layered semiconductors, gallium selenium, indium selenium, expanded graphite, L-aspartic acid, double-matrix structure

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COMPONENTS DECODER OF COMPLEX CHANNEL WITH ORTHOGONAL CARRIERS FREQUENCY DIVISION (p. 11-14)

Vladimir Belov, Anton Belov

There had been presented the result of processing elementary components obtained from the multiplexed signals with Orthogonal Frequency-Division Multiplexing (OFDM), with the analysis of states of these components at particular times and there had also been analyzed their influence on a quality of the Group Signal.

There had been determined that unconditional signal analysis parameter is a value that allows in conjunction with frequency diversity and the number of subcarriers specify the location of subcarriers on the frequency axis. Mathematically there had been analyzed signals of the complex channel with OFDM, with the consideration of the autocorrelation function. There had also been determined the properties of the signals with QPSK modulation, based on the encoding of two bits of information transmitted by one symbol. In this way, the symbol rate is twice less then the information rate.

There had also been determined the properties of the signals with QAM, and the information parameter is a change of both, amplitude and phase, which significantly increases the information capacity of the channel and increases the interference immunity of the system.

There had been determined the properties of the signals with Frequency-Shift Keying (FSK), and Minimum Shift Keying (MSK), which are most commonly used in the modern digital communications, due to their generation (detection) simplicity, and insensitivity to the initial phase, but having uneconomic spectrum consumption for OFDM. There had been developed a block diagram of the components decoder

Keywords: OFDM, a demodulator, Phase-Shift Keying, a model, states analysis, an elementary component

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EFFECT OF Cr_2O_3 ON THE BANDGAP OF TiO_2 THIN FILMS (p. 15-18)

Andrii Mostovyi, Victor Brus, Pavlo Maryanchuk

Titanium dioxide (TiO_2) is a large band gap semiconductor with many interesting properties. This material possesses high refractive index and low absorption coefficient in visible range, which makes it an excellent optical coating material.

Cr_2O_3 seems to be one of the most promising impurities in TiO_2 as it shifts the optical absorption spectrum towards the visible range and improves the photocurrent density of TiO_2.

Titanium dioxide thin films doped with chromium oxide (Cr_2O_3 – 1; 3; mol %) were deposited onto glass substrates in a universal coating system Leybold – Heraeus L560 by electron-beam evaporation.

The transmission spectra of the TiO_2 and TiO_2 - Cr_2O_3 thin films were measured by a spectrophotometer SF-2000 within the wavelength range 200 - 1100 nm with a step of 1 nm.

The effect of Cr_2O_3 concentration on the band gap of titanium dioxide thin films was investigated

Keywords: TiO_2, Cr_2O_3, optical properties, doping, envelope method, impurity, band gap, thin film, the absorption coefficient, refractive index

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GAUSSIAN DISPERSION MODELS AND "CLOUD" COMPUTING FOR 3D ANALYSIS OF THE ATMOSPHERE STATE (p. 18-21)

Mykola Skrypskyj, Vorobets

The proposed method and developed software for a three-dimensional simulation of the spread of contaminants in the atmosphere using the Gaussian dispersion models, "cloud" technologies and software OpenMP allows improving the efficiency of using computing resources. It is achieved by developing a common approach to improving the problem definition of simulation modeling and data preparation.

According to the testing results, the developed program module accelerates computations by 4 times compared to the single-processor system and allows constructing the map of the contaminants spread using the Gaussian dispersion models.

The obtained results prove the feasibility of using the OpenMP software package for the parallelization of computations and indicate the possibility of further software optimization for solving this class of problems according to the criterion of minimizing the computing time by varying the number of parallel threads, processes and involved processor cores

Keywords: “cloud” computing, modeling, Gaussian dispersion model, OpenMP

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A PULSE COHERENT NQR SPECTROMETER WITH EFFECTIVE TRANSIENT SUPPRESSION (p. 21-25)

Alexander Khandozhko, Victor Khandozhko, Andriy Samila

The presence of the quadrupole moments of isotopes of gallium and indium in GaSe and InSe allows applying the radiospectroscopy of nuclear quadrupole resonance (NQR) for studying of the crystal structures of these compounds.

The structure of the pulse coherent spectrometer with a minimum number of functional nodes is proposed.

The source of carrier frequency, oscillations is the frequency synthesizer for filling the probe pulses in the range of NQR resonance frequencies 2 ÷ 50 MHz (isotopes 14N, 69Ga, 71Ga, 113In, 115In).

The nuclear spin induction signal after the amplification is fed to a synchronous detector, made on the balanced mixer. The output power amplifier on the field-effect transistor MRF6VP11KH develops an excitation pulse power up to 1 kW in the receiving coil. Restoration of the NQR spectrum of the spin induction signal is carried out by the fast Fourier transform method.

The circuit solutions on the elimination of the receiving coil “ringing” of oscillating circuit of spectrometer and transient suppression in the receive path of the NQR pulse radio spectrometer are proposed. Safe closing of the receive path in the pauses between probe pulses (up to 100 dB for the carrier frequency) is provided by the scheme of three similar cascades on the dual-gate FET

Keywords: radio spectrometer, NQR, spin induction, Fourier transform, semiconductor, transient, coherence

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EFFECT OF Ca ISOVALENT IMPURITY ON ZnSe<Al> PROPERTIES (p. 26-29)

Mykhailo Slyotov, Ivanna German, Oleksiy Slyotov, Vasilii Kosolovsky

Zinc selenide continues to be an important material of solid-state electronics. The introduction of aluminum during growing the crystals allows significant increasing the electrical conductivity and obtaining low-resistivity material. Electronic type of conductivity is not changed. In this paper, the results of studying the effect of calcium isovalent impurity on the properties of such base material are given. The further doping of ZnSe <Al> by calcium isovalent impurity allows obtaining the surface layers with hole conductivity. Radiation formation in the moderately blue spectral region with quantum efficiency ~12-15 % is important for practical use of such structures. It is conditioned by two components. The dominating component is defined by the annihilation process of bound excitons on Ca isovalent impurities. The availability of Ca isovalent impurities also promotes the interzonal transition of free carriers of charge, which is responsible for the nature of the second radiation component. The formation of Ca doped layers with low-resistivity basic ZnSe <Al>p-n-transition with the rectification factor not less than 10^4 is important for short-wave photosensitivity. Such transitions are photosensitive and cover a spectral region $\hbar\omega$ ~ 2,64-3,42 eV. Such photosensitivity spectra are well coordinated with the radiation spectra of Ca doped layers ZnSe <Al>

Keywords: zinc selenide, calcium, regional radiation, photosensitivit

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OPERATIONAL TRANSCONDUCTANCE AMPLIFIER MACROMODEL OPTIMIZATION FOR ACTIVE PIEZOELECTRIC FILTER DESIGN (p. 30-35)

Andrii Zazerin, Anatolii Orlov, Oleksandr Bogdan

This work addresses the problem of optimal operational transconductance amplifier (OTA) macromodel creation in terms of its application in active FBAR filters. Existing macromodels of active elements are reviewed from their structure and application point of view. A nonlinear macromodel of OTA was developed on the basis of single-pole three-stage macromodel, which takes into account the necessary effects of real devices: the finite input and output impedances, the frequency dependence of transconductance coefficient and its nonlinearity behavior, noise characteristics.

The features of presented solution include versatility of application in most of nowadays CAD systems, the ability to estimate with sufficient accuracy the frequency response of the filter and its performance, dynamic range, harmonic and noise analysis. Simple structure allows the speed-up of calculation and direct digital optimization techniques can be adopted to optimize the characteristics of the filter. The verification of macromodel was demonstrated on the example of FBAR connected to gyrator circuit, which showed high precision imitation of transistor-level circuit.

The analysis of transient response and harmonic balance proved the acceptance of power series approximation of operation range. The use of two diodes outside this range allowed for modeling in wide input voltages range. The developed macromodel can be successfully used for the synthesis of active FBAR filters

Keywords: macromodel, OTA, FBAR, active filter, nonlinearity

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THE USE OF OPERATIONS WITHOUT CARRY IN HIGH-SPEED COMPUTING FREQUENCY SYNTHESIZERS (p. 35-40)

Oleksiy Polikarovskykh, Ivan Trocishin

The use of new mathematical approaches to constructing phase accumulators of direct digital frequency synthesizers without the problem of delay of carry signal distribution from one category to another was proposed in this paper. The causes of delay of synthesized signals and deterioration of their spectral characteristics in direct digital computing frequency synthesizers were considered.

It was found that one of the major causes is the delay of carry signals in the phase accumulator of the synthesizer, based on the accumulating adder. It was shown that, with the increase of the synthesizer capacity, the duration of delays of carry signals starts playing the key role and influences directly such synthesizer parameter as the maximum operating frequency. In the paper, it was determined that one of limiting factors in terms of the maximum speed and qualitative spectral structure of digital frequency synthesizers is the speed of certain arithmetical summing operations in the core of digital synthesizer.

The possibility of applying operations in the Galois field for improving the synthesizer speed was considered. Mathematical operations of adding and subtracting number pairs without the carry were developed.

The same approach can be used for performing operations with greater capacity. The proposed mathematical tool will allow constructing the digital computing synthesizer without the problem of delay of carry signals by some complication of the phase accumulator structure

Keywords: frequency synthesizer, phase accumulator, direct digital frequency synthesizer, accumulating adder

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THE SYSTEM TO ANALYZE OF STABILITY OF ROBUST STEGANOGRAPHIC ALGORITHMS (p. 41-44)

Dmytro Andrushchenko

When building steganographic system for copyright protection, two requirements are presented to the algorithms. First of all, robustness requirement is presented: the resistance level of the data embedded into image to intentional or unintentional container distortion. Second, the requirement of minimal visible container changes when embedding data into an image.

These requirements contradict one another; this is due to the fact that the smaller is value of distortion included into image while information imbedding, the less built-in data capability will be.

Almost all the algorithms proposed allow to vary resistance parameters and the amount of included changes by changing a so-called embedding force coefficient P. Besides this, the data capability depends on format, size, and image palette, as well as on types and degree of distortion (attacks), to which the image may be exposed. Therefore, a compromise is needed between these two parameters for constructing a reliable and effective steganographic system.

This paper describes the software solution developed for a practical evaluation of the stability of steganographic methods for hiding information in digital images.

The results received allow us, when creating the system of steganographic data embedding into digital images, to reasonably choose the most appropriate methods and parameters of algorithms that provide the needed capability level to certain container distortions simultaneously with possible "invisibility" of embedded messages.

Implementation of the most appropriate methods and parameters of algorithm obtained with the help of system developed into information security area will improve the existing steganographic systems efficiency

Keywords: steganography, concealment of information, digital image, copyright protection, analyze of robustness

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ANALYSIS OF RELIABILITY INDICATORS OF SPECIAL COMMUNICATION SYSTEMS (p. 45-50)

Sergey Gnatiuk

The analysis and the classification of indicators of quantitative evaluation of reliability of a special communication system using the systemic approach in their study are proposed. The features of element and structural reliability of special communication systems were considered. It is shown that they belong to complex technical systems. Therefore, to determine and study their reliability indicators, simulation and systemic approach should be used.

Analysis of the composition of the special communication system and interaction between its elements shows that the reliability property, which lies in the ability to provide communication with preservation in time of performance indicators values, established by specifications and technical documentation, is supported by technical communication support subsystem with the performance of all types of repair, maintenance and provision with operational materials and consumables.

Traditionally, the availability factor, which is the serviceability probability of all system elements and the availability of all communication directions for the full operation, is used as the main reliability indicator of the special communication system. However, for special communication systems with more objective characteristic there is the probability of system availability to transfer information between subscribers (communication nodes) at least in one communication direction that in the literature on reliability theory is called the connectivity probability or serviceability probability of at least one of the possible communication directions.

The paper shows that the availability factor is less than serviceability probability.

The equality occurs if each element of the special communication system is used only in one direction and only once without other communication directions

Keywords: reliability, special communication system, hierarchical heterogeneous structure, performance indicators, availability factor

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CORRECTION OF ELECTRODE POTENTIAL OF Si-PLATES BEFORE FORMATION OF POROUS LAYER (p. 50-53)

Mariia Vorobets

The possible interrelation between the value of electrode potential φ_s, surface condition and mechanisms of pore formation of Si was substantiated.

The influence of finishing chemical treatment method on the φ_s of Si-plates was investigated.

Features of φ_s behavior over time in media with different pH values after treatment of Si-electrode in acid-peroxide solutions (including HNO_3) are treated by manifestation of incomplete surface passivation by the oxide film.

It is caused by the fact that, for the course of reduction-oxidation reactions, it is necessary to reach a certain concentration in the HNO_2 catalyst solution, which would "start" the NO_2 recyclization process.

The research results showed that treatment of Si in ammonia-peroxide solutions promotes the formation of Si-OH coating on its surface. This leads to a larger value and stabilization of the electrode potential in neutral and acidic media. In alkaline medium, hydroxide film can turn into oxide by breaking the bonds O-H that leads to the reduction of potential. According to the Pourbaix diagram analysis, the course of reactions with the formation of ionic forms of orto-silicate acid is probable in this area of pH

Keywords: porous silicon, electrode potential, ammonia-peroxide solution (APS), acid-peroxide solution (APS)

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INVESTIGATION OF THE MULTIPLICITY OF NUCLEAR QUADRUPOLE RESONANCE SPECTRA OF ISOTOPES ^{113,115}In IN CRYSTALS InSe GROWN FROM THE MELT (p. 54-57)

Galina Lastivka, Alexander Khandozhko, Victor Khandozhko

For researchers, the problem of interpreting the origin nature of NQR spectra multiplicity is always one of the main experimental tasks.

For the purpose of interpreting the nature of the occurrence of NQR spectra multiplicity in the layered crystal InSe, the

spectra of NQR ^{113,115}In for four spin transitions, the average values of which are only approximately satisfied the ratio ν_1: ν_2: ν_3: ν_4 =1: 2:3:4 were studied. In the studied NQR spectra, two multiplet groups, confirming the presence of polytypic structure in crystals are clearly observed. The feature of multiplet groups is the presence of fine structure with the splitting constant, which is clearly observed for the three higher transitions and constitutes 10 ± 0,5 kHz.

The quantitative similarity of the spectra ^{113,115}In in InSe reflects that the corresponding splitting occurs almost entirely due to the interaction of nuclei In. It is established that for higher transitions deviation is observed. It is shown that, in multiplet groups for higher-order transitions, multiplet groups of lines are observed that, in our opinion, is connected with the presence hexadecapole interaction with the electric field gradient of crystal.

This interaction is caused not only by p-, but also d-, f- electrons in layered crystal with highly distorted configuration of the charge distribution in the vicinity of indium nuclei. In addition, as a result of exciting the electrons d- or f- of the indium atom shell by coordinating interactions, the additional contribution of hexadepole moment in the form of additional lines in the multiplet spectra of NQR may occur

Keywords: spectra multiplicity, structural defects, polytypes, NQR, hexadepole interaction

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