ABSTRACT AND REFERENCES

INFORMATION AND CONTROLLING SYSTEM

EFFECTIVENESS EVALUATION OF SPN-STRUCTURE OF SYMMETRICK BLOCK CIPHER (p. 4-10)

Dmytro Kaidalov, Roman Oliynykov

SPN-structure, along with a Feistel network and a Lai-Massey scheme is one of the most common high-level constructs for building symmetric block ciphers. At the same time, not so many papers are devoted to the evaluation of its effectiveness, so research in this area are extremely important.

The evaluation method, based on the possibility of distinguishing the SPN-structure from a random permutation is considered in the paper. This method was successfully applied to the Feistel network and the Lai-Massey scheme, so it was expedient to apply it to the SPN-structure as well. To solve this problem, the authors have put forward and proved a theorem on the maximum likelihood of distinguishing the SPN-structure from a random permutation. Algorithm-distinguisher that allows to make a distinction with a certain probability was developed for the 2-round structure. Also, it was proved that it is impossible to make a distinction for 3 or more rounds of the SPN-structure.

The results can be used to compare the effectiveness of the SPN-structure with other high-level constructs of symmetric block ciphers.

Keywords: high-level construct, SPN-structure, block cipher, algorithm- distinguisher, random permutation.

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EFFICIENCY OF USING TIMER SIGNAL CONSTRUCTIONS IN THE CITY TELEPHONE NETWORK CHANNELS (p. 11-16)

Oleksandr Ryabukha

New, more efficient transmission methods, providing a necessary transmission quality and the transmission of more information in a given time interval are proposed. Use of time-coding in transmission systems reduces information delivery time by two times compared with BDC (bit-digital coding).

It is experimentally shown that although power distance in timer signal constructions is defined by the area, much smaller relative to the bit-digital code, the probabilities of false acceptance of CW (code word) are not significantly different, and sometimes may be smaller than the bit-digital code.

The results of statistical measurements on these channels are given, and probabilistic characteristics of systems when using timer signal constructions for the information transmission through the city telephone network channels are calculated in the paper.

Keywords: Gilbert model, timer signal constructions, bit-digital codes, transmission system, significant modulation time.

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RESEARCHING OF MODULATION OF RADIATION INTENSITY IN MULTIMODE POLYMER FIBER UNDER SELECTIVE EXCITATION OF MODES (p. 17-22)

Vasyl Varyshchuk, Vasyl Tataryn, Yaroslav Bobitski

When coherent light is propagated into the multimode fiber, a speckle pattern is formed at the exit face of fiber.When the fiber is vibrated, the speckle pattern is modulated due to mode coupling and phase modulation of the propagating modes.In this paper the effect of fiber bends on theintensity modulation of the off-axis modes in multimode polymer fiber has been investigated.

The theoretical analysis of a bend multimode fiber shows that the change of the speckle pattern intensity depends on the length

of the fiber perturbed and amplitude of the vibration signal. When a highly coherent light source is used, the speckle pattern modulation is due primarily to phase modulation of the modes, and the component of the induced frequency overcomes the first and second harmonics with a difference of 13 dB and 18 dB, respectively, which allows clear identification of the induced vibration frequency. In contrast, when less coherent sources are used, the difference between fundamental vibration frequency and its harmonic components are small. Experimentally shown that when the off-axis modes are excited in multimode polymer fiber the amplitude of the output signal depends linearly on the amplitude of the vibration signal. The considered modulation mechanism can be effectively used to detection of the vibration and mechanical oscillation.

Keywords: polymer optical fiber, guided mode, mode coupling, phase shift, interference, intensity distribution of radiation, speckle pattern.

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EVALUATION OF WIRELESS INFORMATION TRANSMISSION CHANNEL SETTINGS OF 802.11 WI-FI STANDARD (p. 22-26)

Dmitry Mykhalevskiy

Analysis of the basic settings of the wireless transmission channel for the 802.11 Wi-Fi standard networks was performed in the paper. For this purpose, channel structure that takes into account all kinds of interference that have a significant impact on the received signal power at the receiver input was proposed. In addition, based on the analysis of the transmission medium and channel settings, expression for assessing the signal power at the beginning of the receive path was obtained.

It was found that one of the main characteristics that affect the wireless transmission channel throughput is the receiver sensitivity level. It defines a minimum allowable signal level at which the receiver can decode data with a set accuracy or set signal/noise ratio level. Another feature of the 802.11 standard is the fact that multilevel quadrature modulation is used to achieve high throughput. This type of modulation has high sensitivity to the transmission channel settings. Using high-order modulation primarily demands strict requirements for the receiver setting.

Based on the transmission path research, it is possible to develop effective methods to assess and control characteristics of wireless 802.11 Wi-Fi standard networks, which should take into account the maximum possible number of influence factors.

Keywords: information transmission, wireless channel, transmission medium, interference, noise, sensitivity.

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FEATURES OF SILICON AND GAAS ON ISOLATOR TECHNOLOGY (p. 26-31)

Stepan Novosyadlyy, Liubomyr Melnyk

It is shown that today the main problem of SOI technology is the low reproducibility of parameters when using high-temperature technology of synthesis and detachment of mono Si layer in a hydrogen atmosphere. Physical basics of the methods for creating silicon-on-insulator (SOI) and gallium arsenide-on-insulator (GAOI) structures using different methods were considered in the paper. Major attention was paid to the «DeleCut» method (ion irradiated Deleted oxide Out), which is essentially a modification of the known «SmartCut» method and is intended to eliminate a lack of basic method.

DeleCut method allows significantly reduce the annealing temperature and concentration of radiation defects in SOI and GAOI structures, decrease the thickness of the cut off layer of silicon or gallium arsenide and the transition layer between the SOI or GAOI layer and hidden oxide (oxynitride). Simultaneously, an increase in thickness uniformity of SOI or GAOI layers and dielectric (semiinsulaedr semiconductor) to several nanometers is achieved.

Keywords: DeleCut method, SmartCut method, CMOS, multicharge implantation, oxynitride, nitric drying.

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INFLUENCE OF TECHNOLOGICAL CONDITIONS OF CdTe:V CRYSTALS ON THEIR EQUILIBRIUM CHARACTERISTICS (p. 32-36)

Orest Parfenyuk, Andrij Kuryk, Mariya Ilashchuk, Nataliia Gavaleshko, Sergiy Chupyra

The equilibrium characteristics of conductivity $\sigma(T)$ and Hall coefficient $R_H(T)$ were researched in temperature region of 290–430 K for CdTe:V single crystal. Samples under study were taken from different parts of the ingots grown by vertical Bridgman technology from synthesized material with stoichiometric content in thermodynamic equilibrium conditions of the phases. The ingots had various impurity concentrations in the melt ($5 \cdot 10^{18}$ and $1 \cdot 10^{19}$ cm^{-3}) and different cooling speed after the growth (500 K·hour^{-1} and 50 K·hour^{-1}).

The grown material was semi-isolating with n-type conductivity ($\rho_{300K} \cong 2 \cdot 10^9 – 1 \cdot 10^{10}$ Ω·cm), rather homogeneous along the ingot, but electron Hall mobility decreased towards the upper part of it. Electric parameters of the samples which were cooled more quickly after the growth did not change after the measuring cycle. Heating of slowly cooled crystals was accompanied by irreversible changes by increase of free carriers concentration and decrease of mobility. The cause of the observed changes may be additional generation of defects of acceptor type during heating which affects the compensation conditions.

Keywords: CdTe, impurity, compensation, defect, thermal stability, changes in stoichiometry, conductivity, equilibrium, mobility, semi-isolating.

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STUDY OF PLASMON RESONANCE PHENOMENA IN METAL NANOPARTICLES AT LOW INTENSE EXCITATION (p. 36-42)

Zinoviy Mykytyuk, Orest Sushynskyi, Mariya Vistak, Vasyl Petryshak, Taras Prystay

The paper presents the results of experimental and theoretical studies of the synthesized gold nanorods with aiming out their subsequent doping in cholesteric liquid crystals. The synthesis of gold nanorods is done with different aspect ratios and by means of TEM, spectral characteristics and Mie theory, their size is defined. Experimental study of nonlinear parameters of gold nanorods is carried out by means of z-scan technique. In particular, the nonlinear absorption coefficients and refractive indices under the action of laser radiation of low power are calculated. These research results of gold nanorods nonlinearity are a prerequisite for further studies of nonlinear processes of composites based on cholesteric liquid crystals with gold nanorods. According to the research of these composites it is proposed to develop the active materials of primary transducer for harmful substances optical sensors.

Keywords: gold nanorods, nonlinear coefficients, cholesteric liquid crystals, gas optical sensors.

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DEVELOPMENT OF ALUMINIUM-BASED METAL-DIELECTRIC STRUCTURES WITH ENERGY-SAVING PROPERTIES (p. 43-47)

Alexandra Borisova, Vladimir Verbitsky, Alexander Machulyansky, Mikhail Rodionov

The spectral-selective characteristics of transparent metal-dielectric structures with energy-saving properties based on nanoscale aluminum layers are investigated. The technique for calculating reflection and transmission coefficients of metal-dielectric structures based on the transfer matrix method which allows to determine the relationship between the electromagnetic response of the metal-dielectric coating with microstructure and optical parameters of its components is presented.

The results of numerical simulation of the spectral-selective characteristics of reflection and transmission coefficients of optically transparent metal-dielectric structures with nanoscale aluminum layers with a thickness of 1–100 nm and antireflection coatings based on aluminum oxide or nitride with a thickness of 200 nm are given. It was found that aluminum-based coatings with thicknesses of up to 5 nm have low-emissivity properties, and with thicknesses of more than 20 nm – reflexive properties. Recommendations on practical use of aluminum-based metal-dielectric structures in energy-saving technologies and possibilities of technological formation of such structures in a single process cycle by vacuum reactive ion-plasma sputtering are presented.

Keywords: metal-dielectric structures; nanoscale layers; spectral-selective characteristics; energy-saving, numerical simulation.

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METROLOGICAL SUPPORT OF THE MANUFACTURE OF FLAME DETECTORS (p. 47-54)

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When developing any product, measures on ensuring the metrological support of its manufacture are taken. First of all, the search and selection of measurement tools of basic parameters, selection of control devices and methods of parameters measurement, study of their metrological characteristics is carried out. Especially when it comes to products that must work in threshold mode and respond to small changes in operating conditions. These devices are flame detectors. Radiation spectrum, which lies in the near infrared region is the most informative for detectors. Radiometers are used for the IR radiation parameters control. IR radiometer was developed for the metrological support of the manufacture of flame detectors.

The results of investigating the metrological characteristics of IR radiometer are given in the paper. Since the primary transducer (photodetector) is sensitive in a wide spectral range, any extraneous optical radiation is background. To reduce its impact, the radiometer sensitivity was limited to the range of 4–5 microns, which is different from the control photodetector sensitivity range. Therefore, the metrological characteristics of measurement procedures were determined as well.

As a result of the studies, high sensitivity in a wide range of irradiance variation – from 0.001 to 20 W/m^2 was confirmed. Conditions of measurement with a relative irradiance measurement error that is within ±6 % was revealed.

Keywords: flame detector, infrared radiometer, irradiance, flame spectrum, IR photodetectors.

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DEVELOPMENT OF Interference ABSORPTIVE FILTERS ON $In_4(Se_3)_{1-x}Te_{3x}$ AND CdSb BASIC CRYSTALS (p. 55-59)

Volodymyr Strebezhev, Sergiy Nichyi, Ivan Yuriychuk, Viktor Strebezhev

Interference absorptive cutting light filters in the near and middle IR-region on the base of $In_4(Se_3)_{1-x}Te_{3x}$ and CdSb crystals are obtained. Substrate crystals and films systems have been investigated by raster scanning microscopy, X-ray microanalysis, optical and electrophysical measurements to determine their suitability for developing effective cutting filters. The optical properties of defects in the crystals and substrates, their influence on the characteristics of the optical filter are studied. Low density of defect is observed in $In_4(Se_3)_{1-x}Te_{3x}$ crystals with [010] growth direction, which is prevailing for the manufacture of optical substrates. It is found that transparency of CdSb and ZnSb crystals and substrates is kept on cooling up to 77 K. The materials for film interference systems of filters different constructions and working range are chosen. Ge-SiO semiconductors are used as a film-forming material for the filters with cutoff in the middle infrared region and Te-SrF_2 in the more far regions. Ontained filters are characterized by the following parameters: cut-off slope k≥0,9, mean passband T_m≥80 %, maximum transmission T_{max}≥90 %. Spectral transmission characteristics of optical filters of various designs are measured, the condition of their mechanical stability and reproducibility of optical parameters are investigated.

Keywords: interference filter; infrared region; spectral transmittance; In_4Se_3, CdSb crystals.

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