

Summaries of all articles

Y.F. Adamov, N.M. Gorshkova, A.G. Sibagatullin

The influence of semiconductor industry on globalization

The semiconductor industry transition to contract manufacturing is reviewed. The integrated circuits design globalization may be possible only if technological and design solutions are unified. After complicated devices are constructed, it is proposed to decentralize the design process using the well-known schematic units previously developed.

Keywords: semiconductor chip, chip manufacture, globalization, nanoscale semiconductor devices, chip design, design tools.

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N.Y. Shitsevalova, N.E. Sluchanko*

New magnetic phase in praseodymium hexaboride

In high quality praseodymium hexaboride (PrB_6) single crystals the angular and field dependences of transverse magnetoresistance are measured in the temperature range $2\text{ K} < T < 8\text{ K}$ in magnetic field up to 80 kOe . The analysis of $\Delta\rho(H)/\rho$ along the direction $H \parallel \langle 110 \rangle$ allows us to detect the existence of the new magnetic phase in the antiferromagnetic (AFM) state of PrB_6 . At the same time the new magnetic phase can be observed in the narrow angular range near $H \parallel \langle 110 \rangle$. The data obtained removes the previous contradictions in the representation of the PrB_6 magnetic phase diagram.

Keywords: hexaborides, magnetoresistance, spin polarization, ferron.

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The Hall effect in NdB_6

The Hall effect is investigated on single crystals of neodymium hexaboride (NdB_6) at temperatures $2\text{ K} < T < 300\text{ K}$ in magnetic fields up to 8 T . It is found that the angular dependences of $R_h(\varphi)$ may be well described by the simple harmonic law $R_h(\varphi) = R_{h0} + R_{h1} \cos(\varphi)$ except the antiferromagnetic (AFM) phase at $T < T_N \sim 7.7\text{ K}$, where the second harmonic contribution turns out to be nonnegligible. The Hall mobility $\mu_H = R_H/\rho$ estimated for NdB_6 is shown to be well fitted by power law $\mu_H \sim T^{-\alpha}$ where $\alpha \approx 0.6$. The drastic decrease in both the Hall mobility μ_H and the coefficient α in comparison with the results of Hall effect investigations for nonmagnetic lanthanum hexaboride (LaB_6) is discussed in terms of the magnetic scattering enhancement of the conduction electrons at the localized $4f$ -states of Nd^{3+} ions.

Keywords: strongly correlated electronic systems, hexaborides, Hall effect, Hall mobility.

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Magnetoresistance in $\text{La}_{0.78}\text{Ca}_{0.22}\text{MnO}_3$

The transverse magnetoresistance is investigated on the single crystals of $\text{La}_{0.78}\text{Ca}_{0.22}\text{MnO}_3$ at temperatures of $60\text{ K} < T < 300\text{ K}$ in magnetic fields up to 80 kOe . It is found that negative magnetoresistance ($-\text{MR}$) may be interpreted in terms of the Yosida theory which describes the scattering of charge carriers at the localized magnetic moments. The value of the local magnetic susceptibility χ_{loc} is estimated by the presented method.

Keywords: colossal magnetoresistance, manganites, Yosida model, local magnetic susceptibility.

A.M. Bulakh, E.A. Vostrikova

Two-dimensional plasmas investigation by the example of a field transistor

The paper deals with the spectrum of two-dimensional plasmas oscillations in THz-range by the example of a field transistor. The Green function formalism is used for calculating the plasma oscillation spectrum in a two dimensional electron channel (2D). The solution of 2D Poisson's equation for the electron channel-shaped configuration of an infinite two-dimensional strip by the method of electric images and the method of limiting transition from a rectangle to an infinite strip is obtained. It is shown that the result obtained by the first method is in agreement with the result obtained by the second method. Both results have the Green function properties. The formulae for the ac potential of the 2D channel are basic for calculating the discrete spectrum of plasma oscillation with frequencies in THz-range.

Keywords: plasma oscillation, field transistor, Green function, Poisson's equation, spectrum of oscillation, 2D channel, THz-range.

A.B. Dubois

Electron-electron interactions in the moderately doped heterojunction $\text{Al}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$

The self-consistent solution of the Schrodinger and Poisson equations and the time dependences of intrasubband electron-electron interactions τ_{ee}^{intra} vs temperature T in the moderately doped heterojunction $\text{Al}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$ ($x = 0.3$) are obtained.

Keywords: intrasubband electron-electron interactions, band structure of heterojunction.

Y.F. Golovnev, D.A. Nurguleev

Resonant transport of a current in heterostructures on the basis of ferromagnetic semiconductors

The processes of the resonant tunneling of electrons in heterostructure EuS/PbS are considered. When describing the quantum transport of electrons in this system it is necessary to consider the interaction of mobile spin carriers with the magnetic moments of localized ions which is done in approximation of electron-magnon interactions by the tunnel hamiltonian method. The expression for the tunnel transparency of a ferromagnetic semiconductor barrier is obtained.

Keywords: ferromagnetic semiconductor, heterostructure EuS/PbS , resonant tunneling, electron-magnon interaction, tunneling Hamiltonian.

A.S. Leychenko, D.V. Negrov, A.S. Raufov, E.P. Sheshin

Thermally expanded graphite as a field emitter for display matrix element formation

The edge field emission cathode made of thermally expanded graphite is considered as an electron source for a cathodoluminescent device. Changing the principle of electron-optical system formation provides for a considerable increase in the cathode operating area per cathode substrate area as compared to the conventional constructions. Using the carbon foil imparts a higher stability and durability to the device saving high emission characteristics. The electron-optical system and electron trajectories modeling for a round cathode is implemented. The proposed construction efficiency for the formation of a localized electron beam and low resolution planar display creation on its basis is demonstrated. The laser irradiation treatment of a carbon foil for cathode holes formation is proposed. The experimental device based on the construction is discussed.

Keywords: field emission, cathodoluminescent light sources, electron optics, carbon materials, laser treatment.

S.Y. Medvedeva

Obtaining optically active structures on the basis of hydroxide and aluminum oxide with metalion addition

This article describes the way of obtaining light-emitting structures based on hydroxide and aluminum oxide with an admixture of Cu, Co, Sn, Pb, Bi, Cd atoms in the form of ions. The conditions of producing these structures are investigated. The whole voluminosity of aluminum oxide glow is obtained. There is a maximum glow of high intensity in alkaline solution. This glow is not present in the acidic environment. It is found that Cu^{2+} ; Co^{2+} ; Sn^{2+} ions cause a glow layer of aluminum oxide in applying AC voltage. The possible applications of this phenomenon are: the production of semiconductors, solar cells, sensors trace ions of some metals, creating plasma formations, etc.

Keywords: plasma electrolytic oxide, porous aluminum oxide, electroluminescence, fluorescence, semiconductors, plasma, lasers.

Y.I. Tishin, D.Y. Adamov, O.A. Somov

Design for production possibility

The major problems of mass production management and limitations are reviewed. The device design suitable for mass production can be described as a combination of appropriate design solutions which are configured according to the features of a particular manufacture process. The choice of a suitable technology process includes experts analysis and device parameters prognoses for the variety of possible device design. When the design is approved, it defines technology and element data bases and intellectual property blocks available.

Keywords: semiconductor chip, chip manufacture, nanoscale semiconductor devices, chip design, design tools.

S.N. Filippov, K.O. Boltar

Investigation of charge transfer mechanisms in HgCdTe photodiodes

We investigate photodiodes using liquid phase epitaxy and molecular beam epitaxy grown HgCdTe layers intended for the detection of radiation in 3–5 μm and 8–12 μm spectral regions. The charge transfer mechanism analysis is based on current-voltage and resistance-voltage characteristics measured as a temperature function in the range of 70–300 K. Current-voltage and resistance-voltage characteristics are simulated, with account taken of diffusion, generation-recombination, interband tunneling, trap to band tunneling, ohmic leakage, and infrared background radiation. The numerical simulation of the measured characteristics allows us to distinguish the current mechanisms and to determine the temperature and voltage ranges, in which a concrete charge transfer mechanism prevails. The temperature dependence of current components is analyzed. Important HgCdTe properties such as the dopant energy level, carrier lifetime, and the trap level are estimated.

Keywords: mercury–cadmium–telluride solid solution, HgCdTe epitaxial layer, infrared photodiode, current mechanisms.

Y.A. Babenkova

Using Auction Theory for developing the optimum Yandex.Direct advertiser strategy

This article considers an example of building the optimum Yandex.Direct advertising campaign (context advertisement) based on fundamental game theory and dynamic systems theory principles. The optimum advertiser strategy search algorithm is developed. The optimum bets for advertisers in the given conditions, when player parameters and query are given are developed. The example shows the unique existence of the optimum bet for the advertiser and analyzes its system parameters dependence (clickability, object value, quantity of advertising sites).

Keywords: Yandex.Direct, context advertisement, auction theory, optimum bets.

A.I. Bachurin, E.V. Lokotilov, M.V. Sedelnikov

Database concept in terms of the conceptualization of the term «housing» for the construction of state housing policy

The paper addresses the problem of the lack of a unified housing policy in the Russian Federation due to the lack of a coherent methodological framework of housing. The study using the methods of the conceptual analysis and projecting of a conceptual framework built by the subject within the proposed conceptual scheme, received a variety of entities of housing. Based on the conceptualization of the housing domain, the structure of the database is built using the theory of strategic planning and management. The study shows that the introduction of these results makes it possible to construct an integrated housing policy.

Keywords: housing, accommodation, housing matters, housing policy, diversity, typology, conceptual analysis and projecting, strategic planning and management, DBMS, database.

A.I. Brilkov

The optimal investment and dividend policy when mandatory dividends grow exponentially

In this paper, the optimal dividend policy based on mandatory dividends exponential growth is discussed and the different aspects of the dividend policy are shown. The general model based on dividend payment bounded from below is constructed. Using the general model, a model based on the dividend exponential growth is constructed. The optimal solution of this model is found in general form. The special cases such as the equality of factory's profitability and bank's rate and the coincidence of the efficiency of bank's rate with the normal dividend growth are analyzed. The sensitive analysis of the optimal solution using the model parameters is made.

Keywords: dividends, investments, profitability, exponential growth, bank rate, optimum decision, policy.

N.V. Efremenko, V.E. Krivtsov

On the «correct» estimation of investor and developer shares in a start-up company

Not only do investments work for the growth of the start-up company value, but also the innovation idea and developer innovation activity. It is not reflected in the classical models of investor share estimation. As a result, the developer share in a successful start-up company can be underestimated. In this paper, the modification of the classical models is presented. It provides a higher estimation of the developer share.

Keywords: start-up company, investments, innovations, investor share, developer share.

A.S. Kopnyshev, N.M. Novikova, I.I. Pospelova

Properties of the majority voting rule

The modification of a three- person game of modeling elections by the majority rule in the case of Condorcet's Paradox, in which players can exchange side payments, is studied. The game takes place in two phases; in the first phase all players may make an open offer by turns to another player to vote for money for a particular candidate. The player who receives a proposal to vote earns the promised money if he votes for this candidate. The second phase is a secret ballot by the majority voting rule with first player's decisive vote in the division of opinion case. Each player seeks to maximize his largest guaranteed payoff. The game results and strategies, which ensure the obtained win of this gain for each player, are found.

Keywords: Condorcet's Paradox, side payments, largest guaranteed payoff, majority voting rule, secret ballot, solution on the dominance.

A.V. Koscheev, N.N. Olenev

Modeling of interacting regional economic systems employing parallel calculations

The aim of model identification is to set model parameters such that the macroactivities of the Russian economy as well as those of regional economies calculated by the model are close to the corresponding statistical and artificially prepared analogues. Search of the values of parameters is implemented through MPI library.

Keywords: modeling, economy, regions, interaction, parallel calculations.

M. V. Leonova

Development of a monitoring system for Russian E-government information resources feedback effectiveness. Quality index

The composite index KI_OS is designed to measure the level of feedback opportunities development for E-government web-sites. KI_OS consists of two indices: Availability Index and Quality Index. The quality index model is described in this report. 83 Government web-sites are evaluated by the KI_OS method. On the basis of the graphic interpretation of Composite index KI_OS, we pose the problem of developing the e-government feedback monitoring system.

Keywords: monitoring, composite index, quality index, e-government web-sites, feedback effectiveness.

I.B. Prusakov, R.T. Falaleyev, S.M. Vladimirov

Web site of the MIPT Museum

The modern technologies of the creation, management and popularisation of web sites by the example of the web site of the MIPT Museum are considered in the article.

Keywords: MIPT, university, museum, website, dynamic content, content management system, Java, database, XML, XSLT, HTML.

A.S. Khritankov

Analytical modeling of distributed systems with a schedule

In this paper, we propose an analytical model for distributed systems. We define a distributed system as a set of collaborating heterogeneous nodes available for the system only part of the time during computations. We introduce the notion of a schedule to describe the availability of nodes. In order to describe the system performance we define its efficiency, peak performance and speedup. We also show that the general parallel system model can be considered to be the special case of our model when nodes are equivalent and available for computation all the time. In the last section, we derive the generalized Amdahl Law for heterogeneous parallel systems.

Keywords: productivity, parallel system, distributed system, computing system, Amdahl Law.