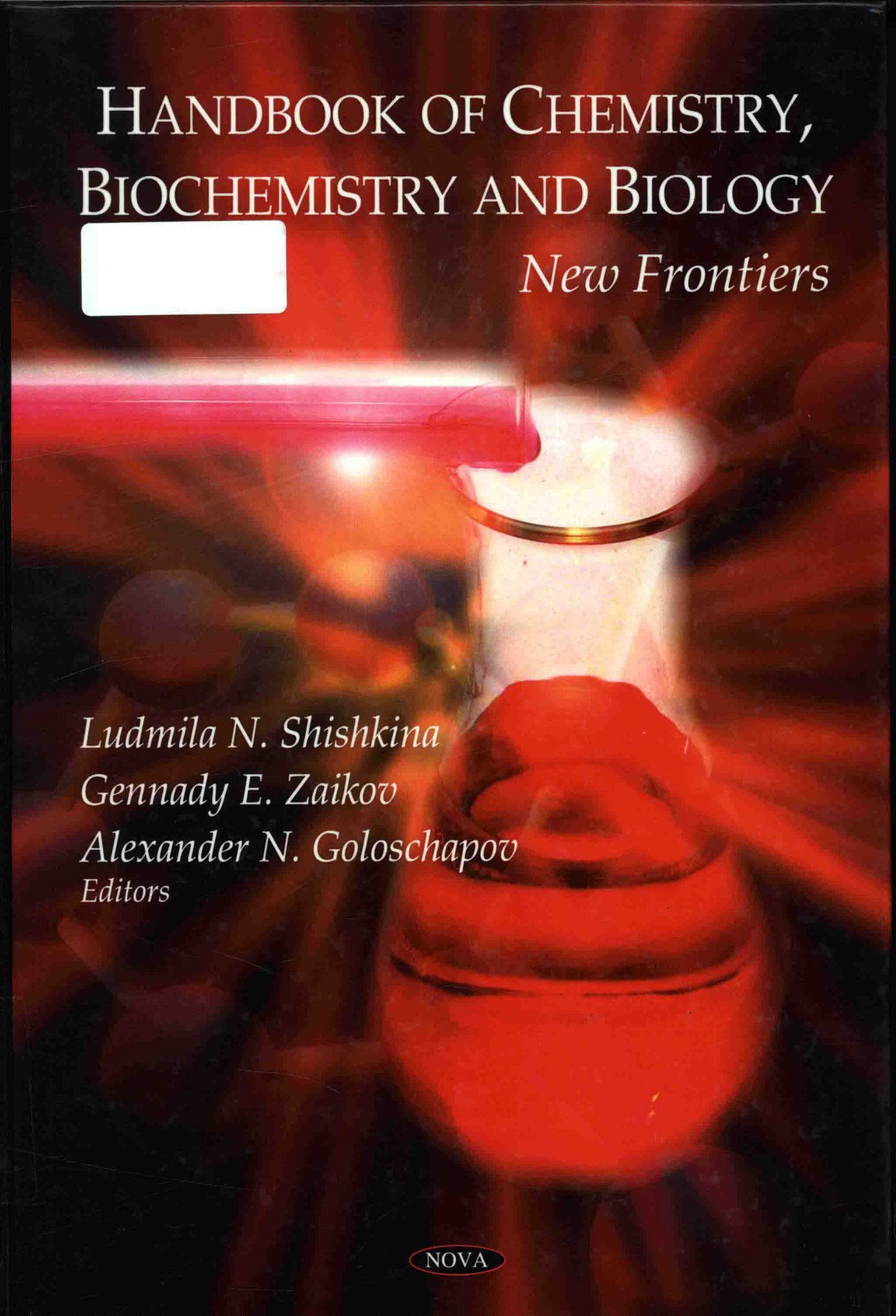
# HANDBOOK OF CHEMISTRY, BIOCHEMISTRY AND BIOLOGY

## *New Frontiers*



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# HANDBOOK OF CHEMISTRY, BIOCHEMISTRY AND BIOLOGY: NEW FRONTIERS

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# HANDBOOK OF CHEMISTRY, BIOCHEMISTRY AND BIOLOGY: NEW FRONTIERS

# PREFACE

The majority of chapters in this book were written by scientists of N. M. Emanuel Institute of Biochemical Physics (IBChPh) of Russian Academy of Sciences. Prof. N. M. Emanuel was one of the founders of biochemical physics – a part of natural science. This science borders on the line of physics, chemistry and biology with integration of mathematics and with practical applications in medicine and agriculture. The book is devoted to these topics. The time has come to show the scientific community worldwide what Russian scientists have recently done in this area. Six chapters of this volume have information about hydrogels in endovascular embolization. Special attention devoted to synthesis and properties of spherical particles (SP) of hydrogels and their medico-biological properties, clinical use of SP, radiopaque SP and their preparation and properties, morphological foundation of hydrogels use for vascular occlusion, antitumor agents methotrexate-containing poly(HEMA)-hydrogels and poly(HEMA) with intensified haemostatic activity as a new embolic materials. The volume has very important information about pharmacological premises of the creation of new antitumor preparations of the class of nitrosoalkylurea and investigation of new mechanism of E.coli resistance to alkylation damages induced by NO-donation agent – a "Quasi-adaptive response". It also includes information about biological activity of different enzymes in process of oxidation in vivo and in vitro, investigation of the properties of lipids in plants and in animals.

Some chapters deal with pharmacological criterions for new antitumor drugs, using of Tocopherols as bioantioxidants in vitro and in vivo, creation of new equipment for chemical engineering, investigation of enzyme reactions, thermodegradation and combustion of polymers and polymer composites, formation of char during of combustion, molecular design and reactivity of some chemical compounds, problems of pethrochemistry, preparation and modification of microparticles, investigation of antioxidants in food products, chemistry of rubber and formation of carbon nanostructures. Several chapters include very important information about application of electron spin resonance techniques for investigation of chemical and biochemical reactions.

Chapter 1 - Investigation of the responses of tissue surrounding spherical hydrogels, after various periods of time from implantation, revealed that a thrombus had been formed on the surface of the embolus and inside the cavities between the hydrogel and the blood vessel immediately after the occlusion. This thrombus is replaced step by step by connective tissue.

Chapter 2 - Experience provided by successful clinical applications of spherical emboli prepared from poly(2-hydroxyethyl methacrylate) and intended for the occlusion of blood

vessels allows the authors to infer that this material, which can be obtained by employing a simple procedure, is nontoxic, perfectly biocompatible, and possesses properties that make it particularly suitable for stopping haemorrhage by the method of transcatheter embolization.

Chapter 3 - It can be seen that in practice a compromise should be sought between particles with a high iodine content, which can be roentgenologically perfectly monitored, and those with a low iodine content, which swell well. Moreover, it is necessary for medical applications that emboli should also preserve a sufficient mechanical stability. These requirements are best met by particles with a 25–30 wt.% of iodine which can be adequately monitored when being introduced into the blood vessels and which also enable the checking of their performance in viva without the necessity for angiography.

Chapter 4 - Clinical observations give evidence to the fact that hydrogel emboli can be considered as a material that is absolutely suitable and can be successfully used for therapeutic occlusion of blood vessels.

Chapter 5 – This chapter allows the authors to assume that emboli made from the modified p(HEMA) hydrogel can be loaded with methotrexate, one of the most frequently used cytostatics. Such a simple MTX-fixation to a p(HEMA)-Hex carrier has the advantage that the pharmacological activity of the drug remains unchanged. The use of p(HEMA)-Hex-MTX hydrogel emboli should enable us to achieve a maximum concentration and a prolonged effect of the cytostatic in the embolized region (tumor) while reducing its concentration in other tissues of the organism at the same time. Thus, there is a prospect of the targeted local palliative cytostatic effect of the drug on the tumor and of prevention of the possible haematogenic formation of metastases, along with a decreased blood supply to this zone or to the whole organ. In other words, the site-specific function of the released antitumor drug could be combined with the endovascular occlusion of blood supply to the tumor tissue.

Chapter 6 - Haemostatic properties of ethamsylate-sorbed hydrogel particles tested on normal healthy plasma were not very distinct. Tests carried out with pathologically changed plasma of the patients suffering from focal alteration of the liver showed a pronounced haemostatic effect of ethamsylate or aminocaproic acid-containing hydrogels. A comparison of haemostatic properties of drug-free PHEMA emboli with those of ethamsylate or aminocaproic acid-treated PHEMA indicate their potential in the treatment to prevent bleeding, particularly for those caused by a disturbed haemostasis system.

Chapter 7 - The principal opportunity of uptake of weakly crosslinked hydrogel emboli is shown by Doxorubicin at different temperatures. Optimal time of process is 1.5–2.5 hours. It is revealed that Doxorubicin is able to diffuse from a polymeric matrix, having a targeted medical effect on surrounding tissue, reducing side impacts on other organs.

Chapter 8 - All living organisms posses mechanisms protecting cells from toxic and genotoxic effects of alkylation damages, induced from endogenous and environmental sources. $O^6$-methylguanine is the major mutagenic base derivative, which strictly modifies base pairing and leads to mutations. To prevent the effects $O^6$- alkylguanine - DNA alkyltransferase (Ada protein) directly dimethylates $O^6$-meG in cellular DNA by transferring the methyl group onto one of their cysteine residues. In E. coli the protective mechanism involves the ada, alkA, alkB and aidB genes expression as well, which is positively controlled by the Ada protein. This DNA repair pathway (the Ada response) is well known as very specific and ubiquitous. Since cysteine methylation at SH groups is the crucial factor for the Ada activation, we assumed that the protein activity can be alternatively regulated by NO – containing agent, via the S - nitrosyl cysteine, functioning in place of S - methyl cysteine in

key position. In the present work a new original mechanism of E. coli resistance to alkylation damages induced by NO-donating agent—a "quasi -adaptive response"—was verified experimentally.

Chapter 9 - The effect of a natural antioxidant α-tocopherol (α-TL) (in concentrations from $10^{-2}$ to $10^{-17}$ M) on the activity of protein kinase C (PKC) isolated from rabbit hearts was studied. Subsequent modeling was performed in terms of kinetic methods. It was shown that α-TL inhibits PKC to a maximum of 80% by a non-competing mechanism. It was found that the dose dependence yields a bimodal curve with the maxima of inhibition at the α-TL concentrations $10^{-4}$ and $10^{-14}$ M. It was shown that the substrate (histone H1) dependences of the PKC activity in the absence and in the presence of high ($10^{-4}$ M) and ultra-low ($10^{-14}$ M) doses of α-TL exhibit maxima at the same concentration of histone H1 (1 μM). The effect can be described by a formal kinetic scheme of inhibition with an excess amount of the substrate. Identification of the parameters of the system was performed with a conjugate gradient technique; the approximation of the experimental results is 98%. A kinetic scheme of allosteric regulation of the PKC activity under the action of α-TL was suggested; the scheme adequately describes the bimodal dose—effect dependence. A good agreement between the experimental and theoretical constants was obtained.

Chapter 10 - Perspectives in the field of creation of highly effective anticancerogenic preparations have been evaluated. For their creation is offered a new regio-selective method of glycosylation of alkylurea in conditions of nucleophilic catalysis with some following nitrosing of glycosyl carbamides of the D- and L-rows.

This method opens principally new possibilities for modification of compounds by means of glycosylamides bond allowing us to get preparations, possessing small toxicity and high selectivity.

Chapter 11 - Influence of serpisten and inokosterone on the phospholipids composition in liver and blood erythrocytes, intensity of lipid peroxidation in tissues (liver, spleen, blood plasma), catalase activity in the liver and general peroxidase activity of white outbreed mice has been studied. A biological activity of ecdysteroid-containing compounds is shown to be associated with an influence on the parameters of the physicochemical regulatory system of lipid peroxidation (LPO). Possessing pronounced membrane-tropic properties due to alterations in the exchange of predominantly choline-containing fractions of phospholipids, ecdysteroid-containing preparations are capable of modifying a cell membrane phase state. A substantial dependence of a biological effect of the compounds on a dose, duration of their application as well as on an intensity of the LPO processes in the tissues and an animal's sex require a more detailed research on the properties of the given ecdysteroids.

Chapter 12 - The influence of composition and physicochemical parameters (the antiperoxide activity, the amount of the TBA-reactive substances, the content of diene conjugates and ketodienes) of lipids isolated from the liver and brain of outbreed mice on the characteristics of liposomes from these lipids has been studied. The data obtained make it possible to conclude that the phosphatidyl choline/phosphatidyl ethanolamine ratio and the diminution of the share of the more easily oxidizable phospholipids have an important role in the formation of liposomes from the natural lipids, and the [sterols] / [phospholipids] ratio in natural lipids has influenced the sizes formed from the liposomes.

Chapter 13 - This chapter is a study of the influence of hydrolysis and centrifugation processes of soybean semifat flour on various indices of lipid components and dynamics of

changes in the composition and characteristics in hydrolyzates within three months of storage. It was shown that processes of hydrolysis and centrifugation, as well as storage, cause reliable changes in the physical and chemical characteristics and lipid composition in hydrolyzates.

Chapter 14 - The structural properties of the superfine iron powder and its interaction with lipid membranes of mice erythrocytes and lipid membranes of egg lecithin liposomes were studied by X-ray diffraction (XRD) and electron paramagnetic resonance (EPR) methods. The superfine iron powder was prepared by the method of heterophase interaction. It was shown by XRD analysis that this powder consisted predominantly of the crystalline iron in the α-form (α-Fe) with the crystal lattice parameter $a$ = 0.2866 nm and the average crystal size about 30 nm. The microviscosity variation of liposome membranes and erythrocyte membranes under the action of the superfine iron powder *in vitro* was analyzed by EPR-spectroscopy. The effect of the iron powder on the lipid membrane microviscosity depended on the powder concentration, the time of the powder interaction with membranes and the type of these membranes. It was shown that the superfine iron powder at the ultra low concentrations had a more pronounced effect on the lipid membrane microviscosity than this powder at high concentrations.

Chapter 15 - This investigation deals with the structural properties of sarcoplasmic reticulum (SR) membranes. SR is the main $Ca^{2+}$-pool in the rabbit skeletal muscle. The principal $Ca^{2+}$-pool functions of the vesicles of fragmented sarcoplasmic reticulum were greatly varied subject to the source of the vesicles' origin. The heavy vesicles are the fragmented terminal cistern SR, which mainly released $Ca^{2+}$. The light ones are the fragmented longitudinal tubules SR, which mainly pumped $Ca^{2+}$. All tested vesicles have some similar and some different structural and functional characteristics that depend on the arrangements of their lipid and protein molecules in the membranes. The lipid-protein relationships were tested with the tryptophan fluorescence quenchers.

Chapter 16 - The problem of clearing of gas emissions is actual now. The efficiency of gas purification can be raised at the expense of working out new more perfect designs of dedusters. In this chapter, new designs of wet dedusters of centrifugal and inertial action are considered. Constructive schemes have resulted. The authors give a description of the principle of how the devices work and investigate their performance in industrial conditions for the clearing of gas emissions. Commercial operation has shown that the developed devices provide high degree of clearing of gas.

Chapter 17 - The possibility of peroxy oligomers production has been examined. Chemical modification of epoxy resins or telomerization of diepoxy compounds with *tert*-butyl peroxymethanol have been used for the synthesis. Reaction conditions have been determined. The synthesis procedure has been developed. The structure of synthesized peroxy oligomers has been confirmed by chemical analysis as well as IR- and PMR-spectroscopy.

Chapter 18 - The fermentative stationary kinetics of hydrogen peroxide decomposition under the action of catalase in the presence of bio*SAS* was investigated. The authors obtained the kinetic parameters of this process. It was shown that the bio*SAS* has an influence on the fermentative process, which can be explained by the change of the fermentative center activity or by the change of substrate concentration. It was determined that the temperature of a process has an insignificant influence on the value of kinetic parameters.

Chapter 19 - The catalytic rate constants for the process in the presence of bioSAS by different concentrations was obtained. It was shown that some constants increase at bioSAS concentration increasing up to the beginning of their micelle–formation. The temperature has

a slight influence on the value of catalysis constants, which can be explained by practically zero activation energies and depends on activation entropy.

Chapter 20 - A comparative study of thermal and thermal-oxidative degradation processes for polyethylene/organically modified montmorillonite (PE-MMT) nanocomposites, prepared by the ethylene intercalative polymerization *in situ*, with or without subsequent addition of an antioxidant, is reported in this chapter. The results of TGA and time/temperature-dependent FTIR spectroscopy experiments have provided evidence for an accelerated formation and decomposition of hydroperoxides during the thermal oxidative degradation tests of PE-MMT nanocomposites in the range of 170–200°C, as compared to the unfilled PE, thus indicating a catalytic action of MMT. It has been shown that effective formation of intermolecular chemical cross-links in the PE-MMT nanocomposite has ensued above 200°C as the result of recombination reactions involving the radical products of hydroperoxides decomposition. Apparently, this process is induced by the oxygen deficiency in the PE-MMT nanocomposite due to its lowered oxygen permeability. It is shown that the intermolecular cross-linking and dehydrogenation reactions followed by the shear carbonization lead to appreciable increase of thermal-oxidative stability of the PE nanocomposite as compared to that of pristine PE. Notably, the TGA traces for the antioxidant-stabilized PE-MMT nanocomposites recorded in air were quite similar to those obtainable for the non-stabilized PE-MMT nanocomposites in argon. The results of treatment of the experimentally acquired TGA data in frames of an advanced model kinetic analysis are reported and discussed. Significant decrease of the combustibility of the PE nanocomposite was shown by a cone calorimeter method.

Chapter 21 - Chemically activated 1-hydroxycyclohexyl hydroperoxide decomposition in the presence of ammonium salts is proposed to proceed through the complexation stage. Complex structure and reactivity have been investigated by molecular modelling methods. Kinetics of the chemically activated hydroperoxide decomposition in the presence of quaternary ammonium salts ($Et_4NBr$, $Pr_4NBr$, $Bu_4NBr$, and $Hex_4NBr$) has been studied. The correlation between reactivity and structural characteristics of ammonium cations was found.

Chapter 22 - The effect of flame retardants on the combustibility and mechanical properties of PVC plasticates based on commercial materials is discussed. The smoke formation of the investigated samples was studied under pyrolysis and combustion modes. It was shown that, by addition of flame retardant to the PVC plasticate, its combustibility can be controlled with retention of the basic performance of the material. It should be noted that the studied method of the plasticate modification allows one to form a strong coke skeleton on the surface of the polymer composition and to avoid the flow of molten material upon burning and, as a result, to prevent flame propagation.

Chapter 23 - A model of the solid state polymerization based on the catalytic role of carriers of the surplus free volume, namely mobile structural defects, has been developed. This model succeeded for the first time to explain most of non-trivial kinetic peculiarities of solid state polymerization.

Chapter 24 - An evaluation was made of the effectiveness of flame retardancy of halogen free flame retardants (FR) as nitrogen compounds that act with phosphorus or boron in relation to unsaturated polyester resins and glass-reinforced polyester resin laminates. The impact of such FR modifiers (applied in desired quantities and various physical forms) on the flammability of polyester compositions and glass-reinforced polyester resin laminates was determined by defining oxygen indices values, with the use of the thermogravimetric methods

and an analysis of the combustion process with a cone calorimeter. The analysis of the thermal decomposition process provided proof of good flame retardancy effectiveness of the tested products, including in the first place nitrogen–phosphorus units and boron-nitric compounds with the observed phenomenon of synergic action of compounds of both atoms. No adverse impact of modification was ascertained on basic strength properties of products.

Chapter 25 - This chapter shows a method of perfecting the after-extract process of high-boiling hydrocarbons from associated petroleum gas at the expense of use of the small-sized tubular turbulent device diverging-converging construction at a stage of absorption by crude oil.

Chapter 26 - The method of obtaining functionalized and modified microparticles via adsorption of the β–diketonates of transition metals on their surface was proposed for the first time. It was shown that the β– diketonates of transition metals, in particular Cobalt (III) acethylacetonate, can be used as high effective initiators of the polymerization "from the surface" of the substrate. The authors studied the thermal stability of the product immobilized on the surface of $Al_2O_3$.

Chapter 27 - Antioxidant properties of lemon essential oils (*Citrus limon* L.) with different composition, of individual limonene and citral, were investigated by capillary gas-liquid chromatography. Antioxidant activity was assessed in model systems by oxidation of aliphatic aldehydes 2-hexenal or 2,4-decadienal to the carboxylic acids. It was found that antioxidant activity of essential oils increased as their concentration increased. Individual citral and limonene had minimum antioxidant activity. The activity of their mixture was more. The differences of stability to oxidation of components of lemon essential oil were determined. The synergistic effects in the antioxidant activity and stability of the main oil component were found.

Chapter 28 - By the nuclear magnetic resonance method in a wide temperature interval, molecular mobility in the vulcanizates of liquid thiokols, vulcanized by the various agents, is studied.

The influence of the nature of the vulcanizing agents and a structure formed vulcanized grids on change of the character of molecular movement of the vulcanizates of polysulphidic oligomers is established. Correlation of the effective ($\upsilon_{eff}$) and the chemical ($\upsilon_{chem}$) density of vulcanized grids thiokol hermetics with parametres of spectra of a nuclear magnetic resonance of the latter is found. Influence of the nature of a vulcanizing agent on features of formation of vulcanized grids of polysulphidic oligomers is discussed.

Chapter 29 - One symmetrical single EPR line centered at g=2.0044±0.0003 with peak-to-peak width of 9.0±0.1 G was detected in non-irradiated green tea samples. The γ-ray irradiation led to an appearance of two weak satellite lines situated around the central signal. Detection of these two satellite lines is unambiguous evidence for irradiation treatment. Intensity of the central line decreased, and satellite lines fully disappeared during the storage of irradiated tea samples. To distinguish a difference between irradiated and non-irradiated tea samples, the changes in intensity of EPR signal in the samples during heating were monitored. The decrease of signal intensity after heating was evidence of past irradiation.

Chapter 30 - The basic idea of this work is to create and to put into practice a new class of diagnostic photosensitizers, namely non-phototoxic photosensitizers, which do not generate singlet oxygen, and exhibit as high luminescent characteristics and tumour-affinity level as modern therapeutic photosensitizers.

Chapter 31 - The atomic structure and elastic properties of silicon carbide nanowires were calculated by density functional theory. The effect of the surface reconstruction and relaxation was observed. The splitting of the SiC geometry to hexagonal and cubic phases was found. The Young's modulus of the nanowires was calculated.

Chapter 32 - The atomic structure and elastic properties of Y-silicon nanowire junctions were theoretically studied and effective Young modules were calculated using Tersoff interatomic potential. It was shown that boundary effects at junctions of different parts of the wires determine mechanical properties of the nanostructures. As the final result, the bending of the wires under external stress leads to the formation of new bonds between different parts of the junctions.

Chapter 33 - It was determined that homo- and copolymers of diphenyldiacetylene and *p*-diethynylbenzene have a high thermal and thermooxidation stability. The amount of coke residue obtained from commercial epoxy-resins is essentially increased upon their modification with added polydiphenyldiacetylene and copolymer diphenyldiacetylene with *p*-diethynylbenzene. Additions of polydiethynylbenzene to commercial olygoetheracrylates improved their thermooxidation stability and strength characteristics of solidified composite materials at high temperatures.

Chapter 34 - Non-isothermal crystallization and melting behavior of low density polyethylene (PE), poly(ethylene-co-vinyl-acetate) (CEVA) and their composites with natural rubber (NR) were investigated using differential scanning calorimetry (DSC). The results indicated that melting and crystallization parameters of PE and CEVA composites are not affected significantly by natural rubber, as well as its content. PE and CEVA in the blends with NR crystallized separately to form the isolated crystalline phase.

The non-isothermal crystallization data were analyzed by using the Avrami equation for low degrees of crystallinity PE and CEVA.

Chapter 35 - The possibility of creating a biodegradable composite material based on propylene-ethylene copolymers supplemented with cellulose, as well as with the woodworking industry waste (powder of different species of wood), was investigated. Investigations into the development of fungi on the given substrata have exhibited a difference in accumulating a biomass for diverse strains. The rate of accretion of micromycetes on composite materials is defined not only by a natural component introduced into the polymeric template, but also by the structure of the polymer material.

Chapter 36 - The dependence of the quantum yield and the decay rate constant on the solvent composition for the carbocations generated in the photolysis of 1,2-dihydroquinolines was studied by steady-state and pulse photolysis in binary mixtures of alcohols with solvents of different polarity, proton donating and accepting ability, and capability for hydrogen bonding. The results were discussed on the basis of the reaction mechanism involving competing reactions of the carbocation combination with two nucleophilic particles, the ROH molecule and the $RO^-$ anion. The kinetic behavior of the carbocations generated from 1,2-dihydroquinolines in the photolysis in solvent mixtures is determined by the polarity, proton donating and accepting ability, nucleophilicity, as well as the ability to form hydrogen-bonded associates between the solvent molecules and between the solvent and solute molecules.

Chapter 37 - The conjugate between chlorine e6 with D-lactose and human serum albumin was investigated by absorption and fluorescence spectroscopy. The strong interaction of the chlorine e6 derivative and the protein was detected. It was found that the presence of

albumin causes remarkable changes in the absorption and fluorescence spectra of the chlorine. The association constant ($2 \cdot 10^5$ $M^{-1}$) was calculated from the fluorescence experiment.

Chapter 38 - At the present stage of development of mankind, in a megalopolis, a person faces the choice of whether to drink piped or bottled water. Because, when making a choice, we must take into account such aspects as hygienic safety, health value and our own financial capabilities, as far as the water is a special product that has no substantiations in human nutrition. Water is the greatest value for any inhabitant of the planet and is among those few elements that are the essence of development of civilization as a whole. People began to understand the strength of interdependency of the quality of water and standard of living relatively recently.

The authors have studied four types of drinking water: tap water, well water, bottled water and mineral water. The results obtained demonstrate quite a clear picture—maximum amount of sterile samples was found from the number of mineral water samples, while none of the well water samples was characterized by the absence of microorganisms. In their research, they used a deep method of sowing in a dense nourishing environment, incubation of sowing, count of all growing visible colonies.

The piped water does not meet the requirements of SanPiN (Sanitary regulations and norms). However, its daily consumption is much cheaper for us than those two cherished litres we need for nutrition purposes. Of course, even when buying the bottled water purified from various types of impurities, there is a risk to buy and drink a counterfeit product, as the growth rate of this market is too attractive for the supporters of a highly marketable business.

Chapter 39 - The laboratory of provision in Plekhanov Russian Academy of Economics has been studying the life cycle of *Boletus edunis* for several years. The research is focused on germination of basidiospores of *B. edulis*, on their sterile isolation and on studies of hymenophore microflora.

Basidiospores were isolated from dried hymenophores of *B. edulis* with two methods. The first yielded dried fungi powder on white sterile paper after exposure of mycothallus cap with hymenophore downside on the paper. Basidiospores dropped from hymenophore tubes and tightly attached to the paper. Spores could be gathered only with scalpel, and it might contaminate basidiospores with extraneous microflora.

The second method of asidiospores isolation: hymenophores were separated from trama, cut into 1 cm pieces and dried in the air on sterile paper, with occasional turning upside-down.

Hymenophore mixture was treated and purified according to the method, developed by us previously and including dispensing, washing, filtration, centrifugation, short treatment with antiseptics.

To verify the sterility, isolated basidiospores were applied to Petri dishes in appropriate medium. Colonies of mold fungi were transferred to tubes, both macro- and microscopic characteristics were determined, and fungi were identified.

Chapter 40 - Germination of *Boletus edulis* basidiospores and growth of primary colonies under laboratory conditions are studied in this work. Apparently the determined first mechanism of germination is peculiar solely to this species of higher fungi. In liquid medium basidiospores swell and decay forming small spherical structures that further aggregate into globules covered with membrane and initiate hyphae.

Unlike the described approaches, the authors studied the process in dynamics: from the onset of basidiospores germination to the formation of microcolonies of vegetating mycelium. The formation of growth tubes has not been detected for *Boletus edulis* for several years of observation.

The study of basidiospores germination was performed only with cultures free of exogenous bacterial or mold fungal microflora which was controlled microscopically and with inoculation on appropriate cultures.

Mycothalluses of mature cepes gathered in central Russia in 1999, 2001 and 2007 were used in this work.

Chapter 41 - The researchers from The Food Microbiology laboratory of the G. V. Plekhanov Russian Academy of Economics have been studying the quality of various groups of confectionery products for more than 20 years, using quantitative and qualitative microbiological criteria. The study objective was to reveal the pattern of changes of microbiological population by studying the time profile of confectionery product contamination against various microbiological criteria during storage. The objects of the study were chocolate products and chocolate sweets. Standard microbiological test methods were used. The study revealed some regularities in quantitative changes of microorganism population in bitter chocolate during storage (measured with standard quantitative microbiological criteria): Mesophilic Aerobic and Facultative Anaerobic Microorganisms, Escherichia coli group bacteria and mold fungi. The examination of the products' microorganism population and its changes during the product storage calls for an assumption about a complex system of relations within the population. On getting into the human digestive system, the population begins a "new life". In addition to a complex system of relations among various groups of microorganisms, the microbial population is subject to quantitative changes in its composition.

Chapter 42 - The dependence of some thermodynamic characteristics upon initial spatial-energy parameters of free atoms has been analyzed. The corresponding equations have been obtained, the dissociation energies of binary molecules and enthalpy of single-atom gas formation have been calculated based on them.

Chapter 43 - Spatial-energy criterion of structure stabilization was obtained. The computation results for a hundred binary systems correspond to the experimental data. The basic regularity of organic cyclic compound formation is given and its application for carbon nanostructures is shown.

Chapter 44 - It is ascertained that struggle and opposition between two basic political and economic systems do not make sense since the most progressive system is the combination of the two. One of the possible variants of such formation is proposed. It is shown that periods of resonances of solar activity have multipronged importance for our planet.

# CONTENTS