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# ***JPRS Report***

# **Science & Technology**

***USSR: Chemistry***

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# Science & Technology

## USSR: Chemistry

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UDC 543.37:541.183

**Hydrophobic Indicator for Luminescent Determination of Oxygen Dissolved in Water**

907M0094H Leningrad ZHURNAL PRIKLADNOY KHIMII in Russian Vol 62 No 10, Oct 89 pp 2376-2378

[Article by I. A. Zakharov and T. I. Grishayeva, Leningrad Technological Institute imeni Lensovet]

[Abstract] Hydrophobic luminescent indicators for the more sensitive and selective measurement of dissolved oxygen were synthesized and studied. Silica gel from the 0.1- to 0.63-mm fraction, bonded with dimethyldichlorosilane, was used as the solid support. Long-term heating of the bonded support in a 300°C oven produced a thinner hydrophobic layer with overall stability as compared with previously reported results. The dependence of mechanical strength on calcium carbonate content can be shifted to higher maxima by increasing the mold pressure. This is due to compensation for low diffusion rates. Increasing the agglomeration temperature had a negative effect on stability, with a local stability maximum at 1,283 K due to nonstoichiometric formation of  $3\text{CaO} \cdot 5\text{Al}_2\text{O}_3$ . The data indicate that it is possible to produce an effective sorbent for recovery of platinum group metals by using calcium carbonate and aluminum hydroxide. During use the sorbent undergoes self-hardening due to solid-phase interactions. The sorbent developed achieved 80 percent relative recovery of platinoids when the sorbent initially contained 2.3 mass percent platinum. Platinum in the sorbent exists as both  $\text{Ca}_4\text{PtO}_{62}$ . Figures 5; references 12: 1 Polish, 1 Czechoslovak, 9 Russian, 1 Western.

UDC 543.253

**Determination of Trace Metal Impurities in "Extremely Pure" Grade Orthophosphoric Acid by Using Polarography**

907M0095F Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 6, Nov- Dec 89 pp 154-156 [MS received 17 Nov 88]

[Article by S. I. Zhdanov, T. D. Nikolayev, V. F. Verdnerina, K. I. Golovanya, L. N. Filatova, and G. V. Gaolchkina, All-Union Scientific Research Institute for Chemical Reagents and High-Purity Chemical Substances, Moscow]

[Abstract] A polarographic method for measuring the levels of antimony, arsenic, lead, cadmium, and zinc ions in orthophosphoric acid was developed in connection with the elaboration of purification methods for the latter. Square wave polarography at a dropping mercury electrode was used. A reducing agent ( $\text{H}_3\text{PO}_2$  or  $\text{NaH}_2\text{PO}_2$ ) was necessary to transform the antimony and arsenic ions to the electroactive trivalent form and to remove interferences from sulfur, selenium, and tellurium ions. In phosphoric acid  $\text{As}^{3+}$  had reduction potentials at -0.42V and -0.5V. The first was used analytically;

the second disappeared at concentrations below  $1 \times 10^{-5}\text{M}$ . The other ions measured interfered with arsenic determination if their levels exceeded that of  $\text{As}^{3+}$  by more than a factor of 50. If the concentration of antimony and arsenic ions exceeded that of cadmium and lead ions by more than a factor of 20 or if the arsenic level exceeded  $5 \times 10^{-5}\text{M}$ , quantitation of lead and cadmium simultaneously with antimony and arsenic was not possible. Treatment of the samples with  $\text{HNO}_3$  and  $\text{H}_2\text{O}_2$  was used to convert  $\text{As}^{3+}$  and  $\text{Sb}^{3+}$  to the electrochemically inactive pentavalent forms. When the levels of the four ions were similar and did not exceed  $1 \times 10^{-6}\text{M}$ , all could be measured simultaneously. The standard addition method was used for quantitation. To measure zinc ions in phosphoric it was necessary to employ inversion voltamperometry with preliminary partial neutralization of the acid to pH 4 by using ammonia solution. A stationary capillary mercury electrode was used. The method developed permits measurement of antimony, lead, arsenic, and cadmium with a lower limit of quantitation of  $5 \times 10^{-6}$  percent and zinc with a limit of  $1 \times 10^{-6}$  percent. References 6: 4 Russian, 2 Western.

UDC 621.928.3

**Intensification of Dehydration Process in Precipitation Auger Centrifuges**

907M0108A Moscow KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian No 1 Nov 89 pp 3-6

[Article by A. A. Nestorovich, candidate of technical sciences, A. G. Kuzmin, and L. A. Noskova]

[Abstract] Precipitation auger centrifuges are used for the separation of various suspensions. There are three ways in which the degree of dehydration can be increased: slower rotation of the auger, faster rotation of the rotor, and a longer dehydration zone; none of them are very productive. A new precipitation centrifuge was designed with an additional rotor and auger attached to the original unit. Both components rotate at the same rate. During transition from the smaller end of the original rotor into the larger space of the newly added rotor the precipitate is broken down and undergoes additional dehydration. This new centrifuge performs better with larger loads. This is due to the so-called "critical moisture" beyond which mechanical dehydration is inefficient; with a small load this additional unit cannot improve the dehydration any more, but with large loads it becomes efficient. Thus it was shown that breaking down the formed precipitate intensifies the dehydration process, especially in the area of "postcritical moisture" dehydration. Because this equipment is somewhat more expensive, each case should be handled individually in evaluating whether this equipment would provide better efficiency. Figures 3; references 4: 3 Russian, 1 Western.

UDC 533.6.011+536.14

**Characteristics of Energy Conversion in a Gas-Dynamic Laser With Feedback Based on Diatomic Molecules***907M0109A Moscow KHIMICHESKAYA FIZIKA in Russian Vol 8 No 12, Dec 89 (manuscript received 15 Nov 88 pp 1594-1597)*

[Article by V. A. Vostryakov and A. M. Starik]

[Abstract] A study examined the mechanism of increased conversion of heat energy into the energy of coherent radiation in lasers with feedback as a function of the kinetic cooling of the diatomic gas flux with resonance irradiation. Calculations performed on the basis of theoretically derived equations showed that the efficiency of a gas dynamic laser's energy conversion may increase by tens of percentage points when the procedure described is used. Thus the introduction of a reversible bond along the optical track of a gas dynamic laser results in a greater energy conversion efficiency due to an altered relaxation rate of the vibrational energy during redistribution of molecules along the vibrational levels as well as to the cooling of the gas flux by this irradiation. References: 6 (Russian).

UDC 541.141.7:538.12:541.515

**Investigation of Geminal Recombination Kinetics of Adsorbed Ion-Radical Pairs by Laser Photolysis Method***907M0109B Moscow KHIMICHESKAYA FIZIKA in Russian Vol 8 No 12, Dec 89 (manuscript received 13 Oct 88 pp 1604-1608)*

[Article by P. P. Levin, V. A. Kuzmin, and I. V. Katalnikov, Institute of Chemical Physics imeni N. N. Semenov, USSR Academy of Sciences, Moscow]

[Abstract] The kinetics of geminal recombination of ion-radical pairs (IRP) adsorbed on optically transparent finely porous glass (FPG) was investigated by the method of nanosecond laser photolysis. These IRP formed during electron transfer from triphenylamine or its tribromo analogue onto a triplet state of 2,6-diphenylbenzoquinone-1,4. The kinetics is described by a biexponential law and is characterized by a time segment of 0.3-1 ns. The cellular effect is 90 percent. Application of a magnetic field leads to an increased fraction of ion radicals in the volume and a slower geminal recombination of IRP in FPG; this confirms the considerable contribution of the spatially separated state of the IRP with little interaction between the radicals in which the T-S transition mechanisms exist and that are sensitive to magnetic fields. The presence of heavy bromine atoms yields a diminished magnetic effect; however, recombination in the zero field does not increase. A 10-fold increase in the recombination rate was noted after the introduction of oxygen. Thus it was shown that the laser photolysis method makes it possible to directly obtain

kinetic information on rapid radical processes in optically transparent glasses such as geminal recombination of adsorbed radical pairs. This process is controlled by means of an external magnetic field, which makes it possible to form organic magnetically sensitive systems from porous glass. Figure 1; references 14: 6 Russian, 8 Western (3 by Russian authors).

UDC 541.124

**Kinetics of Azobenzene Photoisomerization in Vitreous Methanol***907M0109C Moscow KHIMICHESKAYA FIZIKA in Russian Vol 8 No 12, Dec 89 (manuscript received 4 Feb 88 pp 1609-1614)*

[Article by S. Yu. Grebenkin and B. V. Bolshakov, Institute of Chemical Kinetics and Combustion, Siberian Division, USSR Academy of Sciences, Novosibirsk]

[Abstract] Photo-induced cis-trans isomerization of azobenzene in a vitreous methanol matrix was investigated. As the reaction progressed, the quantum yield decreased. The kinetics of this reaction can be described by the sum of two exponents with indices directly proportional to the light intensity. The following model was proposed for this process: there exists a distribution of molecules based on their reactivity that results from the differences in the local matrix surroundings; the more reactive molecules react first, and the remaining, less reactive ones lead to a diminished quantum yield of the reaction in time. It is also possible that there exists a relatively slow reorganization process of the local surroundings that leads to a change in the reactivity of a particle. As a result, an equilibrium is established in the reactivity. Overall experimental results of the photoisomerization of azobenzene indicated kinetic nonequivalence of the reacting components that is caused by differences in their local matrix surroundings. Hence it has been shown to be possible to use this reaction to determinate slow molecular mobility in solid bodies. Figures 4; References 9: 7 Russian, 2 Western.

UDC 535.215.4:537.312.8:678.769

**Effect of Magnetic Field on Photoconductivity of Polydiacetylene Crystals and Problem of Charge Separation***907M0109D Moscow KHIMICHESKAYA FIZIKA in Russian Vol 8 No 12, Dec 89 (manuscript received 13 Feb 89 pp 1670-1679)*

[Article by Ye. L. Frankevych, I. A. Sokolik, A. A. Lymarev, T. V. Rakhovskaya, O. L. Lazareva, G. A. Vinogradov, and A. N. Shchegolikhin, Institute of Energy Problems in Chemical Physics, USSR Academy of Sciences, Moscow]

[Abstract] Polydiacetylene is a model of a quasimonomeric molecular system in which the mobility of charge carriers along the molecular chain considerably exceeds

such a mobility in a direction perpendicular to the chain length. In the present work the effect of a magnetic field on the stationary photoconductivity of polydiacetylene-toluene sulfonate monocrystals was observed experimentally. The characteristics of this magnetic effect were studied, and a conclusion was reached on the nature of primary excitation states determining the yield of the free charge carriers in such quasimonomeric systems. The magnetic sensitivity of the photo flow was found to be

related to changes in the spin states of diffusion electron-donor pairs in which charge diffusion down the polymer chains was possible at a distance of up to 1,600 Å. An assumption was made that the predecessors of electron pairs are charge transfer states forming as the result of an electron transfer down the chain initiated by the action of light; in such states the electron is delocalized down the chain at a distance equivalent to the Onzager radius. Figures 5; references 18: 4 Russian, 14 Western (3 by Russian authors).

UDC 541.128

**Catalytic Decomposition of Ozone Over Activated Charcoal Fabric**

907M0073A Moscow ZHURNAL FIZICHESKOY  
KHIMII in Russian Vol 63 No 10, Oct 89 (manuscript  
received 30 Jun 88) pp 2606-2609

[Article by L. F. Atyaksheva and G. I. Yemelyanova,  
Moscow State University imeni M. V. Lomonosov]

[Abstract] Ozone reacts with various carbonaceous materials such as activated charcoal, soot, graphite, diamond, and carbon fibers. The character of the reaction is affected by temperature and the nature of the carbon surface. In a previous work the reaction was identified as being a deep oxidation with the formation of gaseous oxides of carbon or a partial oxidation with

the formation of oxygen-containing functional groups on the surface. The ratio of these processes changes at high temperature to favor oxidative destruction and the formation of gaseous oxides of carbon. It was hypothesized that a third, not yet isolated process of the catalytic decomposition of ozone also takes place. This is related to the relatively low specific activity of the catalytic sites and their small number on the surface of the carbon material. In the present work a study was made of the relationship of temperature to the above three processes in the case of ozone reacting with activated carbon fiber on a polyacrylonitrile matrix. The results show that catalytic ozone decomposition is the major competing process and that 80-100 percent of all the reacting ozone is decomposed at -80 to +80° C. The remaining ozone is consumed in the formation of oxides of carbon and functional groups on the surface. Figure 1; references 8: 7 Russian, 1 Western.

UDC 66.066-278

### Evaporation Through Membrane as Alternative to Azeotropic Rectification

907M0031A Moscow *KHIMICHESKAYA  
PROMYSHLENNOST* in Russian  
No 8, Aug 89 pp 569-77

[Article by Yu. I. Dytnerkiy, I. R. Bykov]

[Abstract] Evaporation through a membrane is discussed as an alternative to azeotropic rectification. Homogeneous liquid mixtures are separated by partial evaporation through a polymer material driven by a chemical potential gradient. Mass transport during evaporation through the membrane consists of sequential stages of transporting the components of the liquid mixture, sorption by the membrane material, diffusion of components through the membrane, desorption of components passing from the opposite side of the membrane, transport of components to the porous substrate, and transport from the substrate to the permeate. Various liquid mixtures, including azeotropic ones, can be separated by using polymer membranes, and the effectiveness is assessed by using quantitative parameters. Numerous formulas were presented for making the necessary calculations. The specific productivity of separation is determined by using a number of factors. Attempts were made at analyzing the evaporation of different binary mixtures through a membrane by using data for single components. The models for evaporation through a membrane that have been proposed by various researchers are summarized and discussed. A twofold reduction in specific productivity is observed following a 10-15° temperature reduction of the original mixture. The temperature relation of the selectivity of the evaporation process through the membrane is different for each membrane-resolution system. The specific productivity and selectivity of separation during evaporation through the membrane do not depend on pressure above the membrane, but they do depend on pressure from the steam phase. In conditions of a steady system of evaporation through the membrane, the separation factor can be determined with good reproducibility. With respect to specific productivity, however, the results differ widely due to the varying substrates used. The technical and economic aspects of evaporation through a membrane are very important to many branches of industry, and several solutions to the problem of separating azeotropic mixtures are discussed. Among the advantages of membrane evaporating systems are their effectiveness in separating mixtures with a low water content, ease of manageability for long periods of time, ease of product quality control, etc. Using membrane evaporation appears promising for the chemical, petrochemical, dye, textile, pharmaceutical, electronic, etc., fields. Figures 9, tables 3, references 47: 4 Russian, 43 Western.

UDC 66.071.7

### Types and Principles of Organizing Nonheated Adsorption Processes for Purifying and Separating Gaseous Mixtures

907M0031B Moscow *KHIMICHESKAYA  
PROMYSHLENNOST* in Russian  
No 8, Aug 89 pp 586-90

[Article by Yu. I. Shumyatskiy]

[Abstract] Several brief examples of the technological aspects of using nonheated adsorption processes and the equipment for it are presented. The most important field of using the drying and purifying devices is that of producing protective substances for metallurgy and agriculture. Nonheated units are also used in the medical, aviation, welding, chemical, and metallurgical industries and in water purification. They are used for extracting hydrogen from petrochemical flows and in the production of synthetic ammonia. These processes occur at room temperature. These nonheating processes are implemented by alternating stages that depend on the specifics of the given process. An adsorption system patented by Skarster is discussed. Gas purification has been a traditional field for using adsorption technology. In the nonheated process, it is not necessary to add or remove heat, and thus the cycle is driven by the contents of the component and its ability to adsorb. Methods of conducting each of the four stages of nonheated processes are discussed, and they yield seven classes of nonheated processes. Setting the pressures and selecting the class to be used is done by considering the purpose of the process. The effectiveness of the adsorption separation process is characterized by four indices: content of whole component in the product, C; its yield, S; intensity of the process, J; and specific energy costs. Nonheated processes of purifying and separating gases are a new standard process for gas preparation. Figures 5, table 1.

### Bureaucrats From Democracy

#### Environmental Pollution

907M0049A Moscow *SOTSIALISTICHESKAYA  
INDUSTRIYA* in Russian No 236, 15 Oct 89 p 3

[Article by Grigoriy Glebovich Bazhutin, *SOTSIALISTICHESKAYA INDUSTRIYA* correspondent in Perm: "Bureaucrats from Democracy"; first paragraph is *SOTSIALISTICHESKAYA INDUSTRIYA* boldface introduction]

[Text] Grigoriy Glebovich Bazhutin, our own correspondent for the Perm and Kirov oblasts and the Udmurt ASSR, has started to work. We are publishing his first correspondence from this region.

"Consider, if you support the "green" movement and if you have decided to cause plants to close, then you will have to fight with the whole plant collective."

With such a categorical (if not to say bellicose) announcement, Deputy Director V. Shilnikov met me at the Perm Chemical Plant imeni S. Ordzhonikadze. And stormy events have resulted that are spreading at this enterprise and around it.

Even at the beginning of the summer, the Perm gorispolkom at its meeting examined the information of the city sanitary-epidemiological station about the extremely unfavorable ecological situation that has developed at the chemical plant and in the Ordzhonikidze Rayon. The decision was made to impose the undertaking of emergency measures for reducing industrial emissions. In this document they wrote that if measures are not taken in 3 months, the old plants that are most dangerous to the environment will have to be shut down.

Time passed. The amount of toxic emissions was not significantly reduced. But when the time came to shut down the shops, a more-than-strange communication was received by the gorispolkom. The plant administration notified them that it could not comply with the ispolkom's decision because the power has essentially passed from its hands into those of the selected workers of a temporary emergency committee. And the committee had voted against shutting down plants. The Sanitary Epidemiological Station went out to the plant but was literally turned away at the gate. It was found that the temporary emergency committee had decided not to allow either the sanitary doctors of the State Committee on Nature or inspectors into the enterprise. And the public prosecutor was not allowed to go further.

What lofty idea has lifted the people to this "antistrike"? In whose name have they come into conflict with the law?

"In the name of the interests of the government, the plant, and 3,500 of its workers, who have the constitutional right to work," cadre worker V. Novikov responds confidently.

According to the firm conviction of members of the temporary committee, the Sanitary-Epidemiological Station supplied the isopolkom with biased information, and it made a hurried and erroneous decision. Naturally they are not emitting ambrosia here, but rather toxic intermediate chemical compounds. But, indeed, they have worked a great many years, he says, and nothing and no one has closed a shop. Now, such a formulation of the problem is not at all understood. In fact, in recent time at the chemical plant, much has been done as never before to protect the environment. Dust and gas scrubbing equipment is being installed. Plant engineers at one of the plants built an original device for purifying vapors. And workers have organized an around-the-clock patrol of the shops and in this way strive to strengthen technological discipline. Recently the ministry made a decision to renovate the plant. Funds had already been allocated for it, and work had begun.

The arguments of the plant managers sounded impressive. And it would have been difficult not to agree with them if it were not for a copy of one authoritative paper, which, by the way, I succeeded in obtaining with great difficulty by using a semilegal system of connections endorsed by local "greens." This document, which was signed at that time by Minister of the USSR Chemical Industry F. Yunitskiy, contains these lines, "The plant is a significant source of environmental contamination. Some of the shops are physically obsolete, and it is not feasible to renovate them. In regard to this, a decision was made by the Ministry of the Chemical Industry on an agreement with the Perm obkom of the party on changing the profile of the plant. At the same time, closing of old plants is proposed.

I ask for special attention to be paid to the date — June, 1977. It is unbelievable, that's all. Twelve years ago the shops were acknowledged to be unsuitable either for operation or for renovation, but now great prospects are linked with them.

Today 412 sources of environmental contamination have already been recorded at the enterprise. And the enterprise could equip only a small proportion of them with purification devices. And those are basically either obsolete or homemade. The efficiency of these facilities is very low. It is not surprising that the total mass of harmful emissions continues to grow precipitously. Data on volatile industrial wastes are especially disturbing. The amount of them has increased by 22 percent per year.

The plant wastewater system is constantly out of order. A considerable proportion of the lines empty right into the Kama. The plant territory itself is being converted into a poisonous dump. The Perm Chemical Plant produces more than 10,000 metric tons of liquid and solid wastes annually. Among them there are substances that are especially poisonous, that belong to the most dangerous class.

Now it is impossible to determine even approximately the scale of the ecological damage, the reason for which is this old Ministry of the Chemical Industry monster. Inured not to show "excessive" curiosity, the Perm City Health Department for many years was simply not prepared to investigate how emissions from the chemical plant affect the health of people (although any district doctor here knows how many ailments, especially of young patients, are precisely from bad air or contaminated water).

It is reliably known, for example, that in the region of the plant, the content in water and air of even those harmful substances whose emissions are controlled exceeds the maximum allowable concentration many times over. At least 55,000 people — the inhabitants of the three closest workplace microrayons — breathe this air. A little below the chemical plant is the large Kama water supply, from which about a third of the population of a city of 1 million drink.

And there is one additional remarkable detail. The physicians of the rayon Sanitary-Epidemiological Station calculate that the mortality of "young" retirees from the chemical plant (who have gone on a pension here 5 years previously) on the average is twice as high as the average of other Perm inhabitants of the same age.

Let us remember the very recent past, when all information about the environmental contamination "on an enterprise scale or wider" was under the reliable protection of the censor. Only dim rumors reached the collective that the sanitary-epidemiological station had some sort of grievance against the enterprise. All the problems with the sanitary-epidemiological and nature protection agencies were decided either in the director's office, behind closed doors, or in the ministry. There, formal documents were signed about millions in fines. There, it was decided how it was to be with directives about the plant being an illegal water user and its administration being an infringer of Soviet legislation.

There, far away from the eyes and ears of the workers, stormy debates took place when the sanitary-epidemiological station tried to shut down the most harmful productions. It turns out that in recent years more than 20 such attempts have already been made. But, as V. Korovka, head physician of the city station, explained, the decree had to be rescinded the next day every time. Why?

"The telephone law," said Vladislav Grigoryvich, lifting his hands in dismay, "they could not stand up against the powerful easy money from above, including from the Ministry of Health.

Some data on the harm inflicted by the chemical plant leaked out just the same from the folders with the signature stamp "for official use." Due to "greens," they fell into the hands of the Perm VECHERKA and were presented at meetings. However, in the collective of the chemical plant itself they were perceived with obvious distrust. The administration here launched its own measures in order to produce immunity of the workers "to any unhealthy rumors." An emergency committee was also established on the crest of this wave. It came into existence at the initiative of the plant director. And not the workers, but Deputy Director V. Shilnikov, headed it.

Rumors, which were widely spread in the collective, of mass discharges that would have to result from the shutdown of production turned out to be a bluff for clean water.

Even if the most dangerous shops were not converted to a different profile but simply closed, which in principle should and cannot be, approximately 350 workers would have to lose their jobs. However, they, naturally, could be assigned to other shops. In addition, the neighboring Iskra Association has expressed readiness to accept these people in its account for retraining and providing work. In truth, the only ones who can actually suffer are the plant administrative apparatus.

What is to be done? Before taking any steps, a serious comprehensive analysis of the situation that has developed is necessary of course.

For the plant, probably, it is reasonable, without waiting for funds, to invite scientists and to propose to them that they work out a model development of the enterprise on a competitive basis. The requirements of the State Committee on Nature to move all harmful plants to another area far from the city and the river and also to maintain the condition laid down by full cost accounting — by changing the profile of old shops and developing more profitable products — must be taken as the starting points here.

With my whole heart I support the readiness of the workers to accept responsibility for the fate of the enterprise. Only the way they apply their efforts clearly must be different. Whose interest do they defend today? The government's? The plant's? Their own? Indeed, it is no such thing. If you look into this, you conclude that they have become a wall for the protection of the elementary muddle-headedness and incompetency of the leaders.

### Ecological Problems

907M0049B Moscow SOTSIALISTICHESKAYA  
INDUSTRIYA in Russian No 234, 13 Oct 89 p 2

[Article by N. Rybakov, head of the sector of the USSR Committee of the People's Control, Moscow: "Reform for the Sake of Form?"]

[Text] Chemical industry enterprises have been operating under new management conditions for more than a year and a half. What has changed? Audits by the Committee of the People's Control and the USSR Ministry of Finances show that economic reform in the sector in many ways bears a formal character. The mechanism of economic methods for operating at a higher level of production efficiency as a matter of fact has not yet been developed. Previously, standards and tasks were established for enterprises without consideration of the specific characteristics of the production. Faulty practice has been retained in which the outlays for the unprofitable part are concealed by well-operated plants and associations, and this sharply reduces the economic interest in operating results. Above-plan financial losses in the sector last year not accidentally comprised more than 60 million rubles. The amount of the State subsidy this year has been increased by almost a third by the ministry. But this has not saved it. Losses in the family of unprofitable enterprises in the last half year rose twice the amount planned.

The Tadzhik Tadzhikhhimprom Production Association has been unprofitable for 10 years. When it was planned and built, they expected to obtain a profit of 100 million rubles. Actually the losses have exceeded twice this figure. In the first 3 years of the five-year-plan, the financial assistance granted it comprised 80 million rubles. Nevertheless, the average monthly wage of the

workers last year was 12.3 percent above the average in the sector. It is a paradox indeed: the worse you work, the more you get!

Plans have systematically not been met at the Sivashskiy aniline dye plant. Capacities are poorly used, the rules for operating machines and apparatus are grossly violated, equipment frequently gets out of order, and the above-standard inventories of trade-material value are growing. And what steps are being taken? Indeed, nothing! A commission established at the enterprises for combatting unproductive outlays is working ineffectively and often disregards obvious facts of mismanagement.

Here is an example. In October of last year the Shevchenkov Plastics Plant shipped four metric tons of polystyrene plastic products by plane to the address of the Lutskiy plant (of its own ministry). For almost a year it lay at the Vnukovo Airport in Moscow. Aviators literally deluged the consignee and at the same time the sender with letters and telegrams as to what should be done with the shipment. Some answer that this product was not ordered, and others were completely silent. In this time, the amount paid for storage of the polystyrene exceeded its value by a factor of 10! We shall note that we obtain a considerable proportion of this product by import.

It would seem that under the new conditions it is imperative to reduce losses of raw materials and energy resources. But this is not the case. The tasks for lowering the standards for their consumption are chronically not met. Thus, of 19 kinds of raw materials (product list of the USSR Gosplan), overexpenditure was allowed for 9. At the Sterlitamak Soda Production Association last year the departure from established standards for expenditures for raw materials and energy resources brought about a rise in the prime cost of production of almost 6 million rubles. And no one will take material responsibility. In addition, at the Sayansk Khimprom Production Association, with an overexpenditure of resources for five kinds of products, the shop workers, including their leader, were paid more than 36,000 rubles in bonuses.

The use of wastes in the sector has remained at a level of 40 percent of their total amount. More than 10 million metric tons are destroyed, and the remainder is stored. At the same time, more than 100 million rubles per year are spent. For example, at the Kalush Khlorvinil Production Association less than half of the solid and liquid production wastes is utilized. The remainder is buried in storage yards and hauled to dumps where it threatens the Dnestr and sources of potable water with contamination. Meanwhile, in 1982 according to a decree of the USSR Council of Ministers it was planned to build facilities for reprocessing these wastes. But up until now their construction has still not begun. What have we lost? Annually we could have produced 660,000 metric tons of sodium chloride, including more than 400,000 metric tons of food grade, and we could have completely

stopped importing it for the production of caustic soda. And the ecological situation would have been improved.

This shows a serious lag in the technical reequipment of chemical enterprises. In many cases the plants have reached such a state that it is impossible to turn out production without enormous expenditures for raw material and other materials. But the ministry goes for this. Instead of carrying out renovation, capital expenditures are dispersed for numerous construction jobs and projects. Thus, last year's plan included 214 construction jobs with more than 4,000 production projects. With the average sector construction time of three and a half years, they are taking almost double that time for construction. The "unfinished" construction increases from year to year. But the exhaustion of basic operating funds is constantly increasing. More funds need to be directed toward their maintenance in an efficient state. Expenditures for repairs are constantly rising. Now they comprise about 1.5 billion rubles — almost 80 percent of the annual volume of capital investments.

The new economic mechanism does not motivate the collectives to take on a stepped-up plan task. Every second enterprise operating according to the first model of cost accounting [khozraschet] has made provision for a profit of less than that of the original plan. In the lexicon of plant workers, the phrase "vested interest with caution" has appeared. This means not to be in a hurry to disclose everything because the higher agencies may clip your wings. Practically everyone has adopted this formula, and therefore shifts to the better are extremely modest. Planning as before is carried out from the achieved, and the accounting — from gross indicators.

What, then, is the outcome? One need not invent it. The USSR Peoples Deputies made business-like suggestions: it is necessary to grant the enterprises true and not imaginary economic independence. Now, however, enterprises, depending on the wish of one or another leader of the department, can obtain either "good" or "poor" economic standards and be foremost or backward. Only scientifically based multiple standards for similar subsectors of industry and established for a long period can become a stimulus for economical and efficient use of material resources and for an improvement of work. Unfortunately there are no constructive programs for this in the USSR Ministry of the Chemical and Petroleum Refining Industry.

#### Natural Gas Instead of Kerosene

907M0049C Moscow SOTSIALISTICHESKAYA  
INDUSTRIYA in Russian No 236, 15 Oct 89 p 2

[Article by V. Lagovskiy: "On the Eve of the Event, an Airplane Flies to France"; last five words of headline are in boldface]

[Text] An international symposium will be held from 17 to 20 Oct in the French city of Nice on problems of using liquefied natural gas. The USSR Ministry of the Aviation Industry has planned to demonstrate an airplane

there that is capable of flying on a kind of fuel very unusual for aviation. The unique gas airliner, the TU-155, departs in a round trip to France through Bratislava.

V. Orlov, chief designer of the Kuybyshev Trud Production Association and one of the designer of the engines of this machine, describes the forthcoming demonstration.

"The TU-155 is an experimental machine with a small gas tank. Therefore, two engines of the three in it are the usual kind. Only one is reequipped for operating on the new fuel. But it makes it possible to conduct all the necessary tests and to verify the reliability of the on-board systems. And the main thing to show is that it is completely feasible to fly on gas. And we have accomplished this task — to reequip the engine for the load forces of take-off, landing, and cruising conditions. Work is continuing, and a plane wholly converted to gas is not for mountains.

It is no secret that what attracts us most of all is the possibility of economizing on other fuel. For our Western colleagues, the interest is ecological. The reequipped airliner will give off 35-40 percent less of nitrogen oxides into the atmosphere than its kerosene relative. It is also possible that both will stimulate the world to begin to convert air transport to gas. And this process is already used in ground transport.

The TU-155 is not a novelty to Soviet specialists. In the memory of many of them are its tests last year on hydrogen and the flights this year on liquefied natural gas. And our Western colleagues first became closely acquainted with this machine at the recent symposium Aviation of the 21st Century. And they were interested. Their unanimous opinion is this: we have overtaken them in the use of alternative fuels by 5 years. Many

remarked that the Soviet designers have extremely successfully solved many problems relating to conversion to gas. Indeed, at first glance it seems simple to convert kerosene to them. Special insulating tanks for fuel storage at minus 156 degrees and a special system of feed and regulation need to be developed. In a word, essential changes need to be made in both the engine and the airplane. We intend to share this experience directly with the gas producers.

UDC 661.723.24-13

### **Start-Up and Assimilation of Carbon Tetrachloride Production Using Degradative Chlorination of Chlorohydrocarbons**

*907M0065G Moscow KHIMICHESKAYA  
PROMYSHLENNOST in Russian  
No 9, Sep 89 pp 643-649*

[Article by Yu. A. Treger, L. N. Zanaveskin, L. M. Kartashov, L. N. Balashov, L. M. Reynish, V. P. Khalilov, V. I. Emelyanov, V. I. Kharitonov, S. G. Mishakov, and V. S. Levanovich]

[Abstract] Chlorolysis, which is high-temperature chlorination under pressure, completely converts almost all of the original raw material (industrial waste products) into carbon tetrachloride, the high yield of which is another advantage of chlorolysis over other high-temperature chlorination methods. Problems with this method are the complexity of the apparatus and production of carbon tetrachloride alone, which has a limited demand. The entire process of using the equipment is described, and the numerous problems associated with putting it into operation are discussed in detail. The assimilation of this process was delayed due to mistakes made in construction and in the development of production. Figures 3, tables 2, references 10: 7 Russian, 3 Western.

UDC 541.183;541.13

**Electroosmosis in Mixed Monolayer of Ionite and Intensification of Electrodialysis***907M0020A Kiev KHIMIYA I TEKHOLOGIYA VODY in Russian Vol 11 No 9, Sep 89 (manuscript received 04 Apr 89) pp 771-776*

[Article by S. S. Dukhin and N. A. Mishchuk, Institute of Colloid Chemistry and Water Chemistry imeni A. V. Dumanskiy, Ukrainian Academy of Sciences, Kiev]

[Abstract] A theoretical foundation is laid for a method that can be used to create conditions in the channel of an electrodialyzer such that the concentration polarization has no negative influence on the process of electrodialysis. The introduction of a mixed monolayer to a desalination chamber causes the current to increase by some tens of times and the thickness of the convective-diffusion layer to be an order of magnitude less than that in ordinary industrial electrodialyzers. Figures 2; References 10: 9 Russian, 1 Western.

UDC 541.135-16:537.311.1

**Concentration Dependence of Electrical Conductivity of Solid Electrolytes Based on Zirconium Dioxide***907M0059A Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 6 Jul 88) pp 1313-1316*

[Article by A. N. Vlasov, Electrochemistry Institute, Urals Department, USSR Academy of Sciences, Sverdlovsk]

[Abstract] The electrical conductivity of several solid electrolytes that are cubical solid solutions with a fluorite-type structure were studied in relation to concentrations of gadolinium, holmium, and calcium. The  $ZrO_2-Ho_2O_3$  system was used for most of the research. As the  $Ho_2O_3$  concentration increases, the values of the preexponential factor and effective activation energy in the high-temperature sections of the temperature dependence of electrical conductivity approach those values found in the low-temperature sections. The concentration dependence of the effective activation energy for conductivity is also observed in solid electrolytes based on cerium oxide, and thus it may be assumed that the laws for altering electrical conductivity also hold true for solid electrolytes such as  $MO_2-R_2O_3(RO)$  ( $M=Zr, Hf, Ce, Th$ ) that have a high concentration of electrically charged defects. Figures 7, references 7: 5 Russian, 2 Western.

UDC 538.945.541.135.5.001.5

**Researching Electrochemical Behavior of Electrodes Made of High-Temperature Superconducting Ceramics***907M0059B Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 7 Sep 88) pp 1326-1329*

[Article by S. N. Slyusar, I. A. Borovoy, N. V. Pogorelova, and I. P. Kraynov, Monokrystallreaktiv Scientific Production Association, Kharkov]

[Abstract] The electrochemical behavior of electrodes made of high-temperature superconducting ceramics in aqueous and aprotic solvents was studied. An experimental electrode was made of superconducting ceramics with the chemical formula  $YBa_2Cu_3O_8$ , and the control electrode was made of platinum or saturated calomel. It was suggested that the ceramic electrode is gradually degraded from the surface down, thus destroying its superconducting properties, and an explanation for this degradation was presented. The behavior of ceramic electrodes in solutions containing an electrochemically active substance was researched by using heptylviologenbromide as the active substance. It was noted that using an electrode made of a superconducting ceramic as a cathode requires rather high current densities for the electrochemical reactions to proceed. Polyaniline films precipitate onto superconducting electrodes in the oxidation of aniline salts, and the films of these conducting polymers may be used as a water-resistant protection as well as functional material in various electronic devices. Figures 4, references 3: 2 Russian, 1 Western.

UDC 541.138.3.547

**Electrochemical Reduction of Cobaltocinium Cation in Aprotic Fluid***907M0059C Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 13 Dec 88) pp 1341-1347*

[Article by N. M. Alpatova, L. I. Krishtalik, E. V. Ovsyannikova, E. V. Leonova, and V. L. Shirokiy, Electrochemistry Institute imeni A. N. Frumkin, USSR Academy of Sciences, Moscow, Heteroorganic Compounds Institute imeni A. N. Nesmeyanov, USSR Academy of Sciences, Moscow, and Physical and Organic Chemistry Institute, BSSR Academy of Sciences, Minsk]

[Abstract] The two-step reduction of cobaltocinium in acetone, dimethyl sulfoxide, propylene carbonate, and 4-butyrolacetone was studied. Tetrabutyl ammonium tetrafluoroborate and lithium chloride were used as base salts. The electrochemical behavior of cobaltocinium was studied by using direct current and alternating current polarography and cyclic voltammetry. To check the accuracy of the curves produced by the instruments, each step of the reduction was studied separately. It was shown that a cobaltocinium cation can be reduced to

cobaltocin and then reduced to a cobaltocin anion. Figures 6, tables 3, references 22: 7 Russian, 15 Western.

UDC 541.138.3

### Electrochemical Reduction of Cobaltocinium Cation in Water and Ethanol

907M0059D Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 27 Dec 88) pp 1348-1351

[Article by Ye. V. Ovsyannikov, L. I. Krishtalik, N. M. Alpatova, L. V. Shirokiy, and Ye. V. Leonova, Electrochemistry Institute imeni A. N. Frumkin, USSR Academy of Sciences, Moscow, Physical and Organic Chernogolovka Institute, BSSR Academy of Sciences, Minsk, and Organoelemental Compounds Institute imeni A. N. Nesmeyanov, USSR Academy of Sciences, Moscow]

[Abstract] A study of the electrode behavior of a cobaltocinium cation showed that two-step chemical reversible reduction occurs in several aprotic solvents. Tetra-butyl ammonium tetrafluoroborate, perchlorate, lithium chloride, lithium hydroxide, bidistillate, and ethanol were used to make the solutions. Cobaltocinium adsorbs to the mercury electrode due to its poor solubility in water. It is shown that water and ethanol are such weak proton donors that a cobaltocin anion cannot obtain a proton during electrochemical measurements, but in the presence of reducing agents these liquids are proton donors and may dissociate to molecular hydrogen. Because these actions are practically reversible, the original reaction is slowed down, and this causes the homogenous dissociation of water by many strong reducers to be slowed. Two-step reduction of a cobaltocinium cation may proceed in both aprotic and proton agents. Figures 4, table 1, references 20: 9 Russian, 11 Western.

UDC 621.357.1

### Researching Corrosion Behavior of Platinized Titanium Electrodes During Electrodialysis of Sea Water

907M0059E Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 22 Dec 88) pp 1352-1356

[Article by L. A. Mikhaylova, S. D. Khodkevich, L. M. Yakimenko, Ye. K. Spasskaya, and Ye. R. Shaposhnikova, Moscow]

[Abstract] The corrosion and electrochemical behavior of platinized titanium electrodes during electrodialysis were studied. Research included radiometrically studying the solution rate of the active layer determining the resistance of titanium to breakdown and studying the absorption of the titanium base during cathode polarization. The corrosion rate of platinized titanium electrodes in sea water depends on the current density. Radiochemical experiments showed that with the reverse current,

the corrosion rate of platinum in the anode period of electrolysis and the frequency of switching the current affect the wear on the platinum plating. The service life of the platinized titanium electrode depends substantially on the frequency of reversing the current. The platinum plating should be at least 6-8  $\mu\text{m}$  thick to keep the titanium from absorbing hydrogen during heavy use of the electrodes, and in optimal operating conditions, the platinized titanium electrode should last for 10-20 years. Figures 3, tables 4, references 8 (Russian).

UDC 621.315.592:548.28

### Studying Behavior of Silicon in Aqueous HF Solutions

907M0059E Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 18 Jan 89) pp 1374-1380

[Article by A. Ye. Gershinskiy and L. V. Mironova, Novosibirsk]

[Abstract] The behavior of the electrical volume resistivity and type of conductivity of silicon in aqueous hydrogen fluoride solutions of varying concentrations was studied. The current-voltage characteristics of silicon plates in aqueous HF solutions were examined with respect to concentration of the carriers, type of conductivity of the silicon, light intensity, and HF concentration. The similarity of current-voltage characteristics in a wide range of HF concentrations indicate that all of these processes are identical regardless of the type of conductivity. Because the current is limited by the HF supply, the polishing dissolution of silicon needs to be conducted in a noncirculating electrolyte. Figures 7, references 22: 7 Russian, 15 Western.

UDC 541.138.3

### Temperature Dependence of Polarographic Reduction of Hexavalent Chromium in Solutions of Dihydric Alcohol

907M0059G Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 7 Jan 88) pp 1390-1392

[Article by D. I. Balanchivadze and T. R. Chelidze, Inorganic Chemistry and Electrochemistry Institute, GSSR Academy of Sciences, Tbilisi]

[Abstract] Studying the temperature dependence of the polarographic reduction of Cr (VI) from neutral solutions of ethylene glycol and propylene glycol provided the opportunity of making additional conclusions about electrode reactions being studied. Activation energy values for a number of variables were calculated. A low value of the frequency factor and the poor orientation of the depolarizer on the electrode surface for an electrochemical reaction causes the reduction of chromium from dihydric alcohols to a metal. Figures 3, table 1, references 4 (Russian).

UDC 541.135-16:537.311.1

**Electrical Conductivity and Age Hardening of Monocrystalline Solid Electrolytes Based on Hafnium Dioxide***907M0059H Moscow ELEKTROKHIMIYA in Russian Vol 25 No 10, Oct 89 (manuscript received 15 Jan 88) pp 1394-1396*

[Article by A. N. Vlasov and A. A. Savitskiy, Electrochemistry Institute, Ural Department, USSR Academy of Sciences, Sverdlovsk]

[Abstract] Monocrystals were studied to obtain more reliable information on the volumetric conductivity of a solid electrolyte. The electrical properties of solid electrolytes based on  $ZrO_2$  and  $HfO_2$ , which are crystal chemistry analogues, were also compared. Researching the time dependencies of the electrical conductivity of hafnium dioxide solid electrolytes showed that reduction of their electrical conductivity in time is lower than the critical temperature. The age hardening process for solid electrolytes is reversible. It was shown that solid electrolytes based on hafnium dioxide are very similar to those based on zirconium dioxide but have a lower electrical conductivity and faster age hardening. Figures 2, table 1, references 13: 10 Russian, 3 Western.

UDC 546.53:548:541.13

**Possibility of Nuclear Reactions Occurring Between Deuterium Atoms in Electron Shells of Metal Ions***907M0066A Kiev UKRAINSKIY KHIMICHESKIY ZHURNAL in Russian Vol 55 No 10, Oct 89 (manuscript received 26 Jun 89) pp 1036-1039*

[Article by A. I. Karasevskiy, D. V. Matyushov, and A. V. Gorodyskiy, General and Organic Chemistry Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] It was demonstrated that the reactions  $D + D$  becomes  $3He + n$  and  $D + D$  becomes  $T + p$  occur in the electron shells of metal ions when two deuterium nuclei enter. The change in the energy system when two deuterons move from the interstitial sites of the lattice into the electron shell of the metal ion was considered. The tunnelling of two deuterons from the interstitial sites to the inner region of the ion explains the necessity for supersaturating the metal with deuterium. Thus, the rate of the nuclear reaction is determined by the probability of tunneling between deuterons and more especially by the probability of two deuterons coming from the metal, which depends on other external factors. Figure 1, references 9: 5 Russian, 4 Western.

UDC 543.25

**Reciprocal Effect of Copper and Zinc When Being Assayed by Using Inversion Voltammetry Method***907M0066B Kiev UKRAINSKIY KHIMICHESKIY ZHURNAL in Russian Vol 55 No 10, Oct 89 (manuscript received 6 Sep 88) pp 1039-1043*

[Article by F. M. Tulyuna and S. A. Kozina, Colloidal Chemistry and Water Chemistry Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] The reciprocal effect of copper and zinc was researched when assaying for their trace quantities in water by using a mercury film electrode and the inversion voltammetry method. The reciprocal effect of these elements during simultaneous assaying in water was studied by comparing the heights of the anode peaks of the polarization curves. The reciprocal effects of these elements on the heights of the anode peaks of copper at low concentrations of zinc and of zinc at low concentrations of copper were demonstrated. Electrons may move from the conductance zone of zinc to those of copper and mercury, thereby giving zinc a more positive charge and more negative charges to copper and mercury. With the formation of intermetallic compounds that form due to surplus zinc and copper, only the peak of the element being assayed changes. To prevent reciprocal effects of zinc and copper during simultaneous assaying using the inversion voltammetry method, the more electropositive copper (II) needs to be assayed first, and then, after shifting the potential toward the negative, zinc (II) may be assayed. Figures 3, references 12: 11 Russian, 1 Western.

UDC 546.96:135.2

**Structure and Properties of Electrochemically Precipitated Ruthenium Plating***907M0066C Kiev UKRAINSKIY KHIMICHESKIY ZHURNAL in Russian Vol 55 No 10, Oct 89 (manuscript received 28 Sep 88) pp 1047-1049*

[Article by V. M. Beletskiy, N. Ye. Nechaeva, L. B. Kharkova, G. N. Sosnovskaya, and A. N. Antishko, General and Inorganic Chemistry Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] The relation of the structure and chemical composition of electrochemical ruthenium plating to electrolysis conditions and determining the optimal electroplating conditions were studied. Auger electron spectroscopy and x-ray phase analysis were used to determine the structure and composition of electrolytic ruthenium plating. The effects of varying current densities in ruthenium electroplating were compared, and it was shown that a current density of  $8 \text{ mA/cm}^2$  produces the highest-quality ruthenium electroplating. Figures 2, table 1.

UDC 543.422

**Atomic Absorption Assaying for Trace Elements in Natural Objects With Preliminary Concentration on Modified Carbons**

907M0066D Kiev UKRAINSKIY KHMICHESKIY ZHURNAL in Russian Vol 55 No 10, Oct 89 (manuscript received 22 Feb 88) pp 1050-1053

[Article by A. I. Samchuk, I. A. Tarkovskaya, L. N. Tomashevskaya, and T. K. Bondar, Geochemistry and Mineral Physics Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] An atomic absorption method was developed for assaying for several different metals in natural objects with preliminary concentration on oxidized activated carbons modified with organic reagents. Sorption of the metals on modified oxidized activated carbon was studied in static conditions. Optimal pH values for extracting the various metals were determined. Modified carbons were more selective than nonmodified ones were with respect to metals in the presence of elements like potassium and sodium. The method of atomic absorption assaying developed extracts a high percentage of trace elements. Figures 2, tables 3, references 6: 5 Russian, 1 Western.

UDC 541.14;541.124.13

**Chemistry of Multiphoton Dissociation of CF<sub>2</sub>HCl Molecules at Elevated Pressures**

907M0088E Moscow KHMIIYA VYSOKIKH ENERGIY in Russian Vol 23 No 6, Nov-Dec 89 (manuscript received 16 Nov 87) pp 529-533

[Article by A. M. Velichko, A. A. Nadeykin, and A. I. Nikitin, Energy Problems of Chemical Physics Institute]

[Abstract] Multiphoton dissociation of CF<sub>2</sub>HCl molecules may be conducted at high pressures (up to 13,330 Pa) while still maintaining acceptable process selectivity. At these pressures, multiphoton dissociation involves the frequent collision of excited molecules, and the end products could also include those products resulting from reactions of the excited molecules. A study of the departure of the distribution of the quantity of C<sub>2</sub>F<sub>4</sub> isotopic molecules from binomial distribution makes it possible to separate the excited molecule reaction products from the molecular dissociation products. This method was employed in the present work to establish that the formation of C<sub>2</sub>F<sub>4</sub> is the result of both the recombination of CF<sub>2</sub> radicals and the reactions of excited CF<sub>2</sub>HCl molecules with one another and with N<sub>2</sub>O. Figures 4; references 5: 1 Russian, 4 Western.

**Guiding Thread of Theory**

907M0157A Moscow PRAVDA in Russian 27 Feb 90 p 2

[Article by V. Goldanskiy, Yu. Molin, and M. Kabachnik: "Guiding Thread of Theory"]

[Text] Our society should know that we are not lagging in any fields of science. Soviet scientists occupy the leading positions in world science in many important directions, especially related to fundamental research.

One of these fields is physical organic chemistry. One can state with satisfaction that the position of Soviet chemists in this extremely important field is very strong. Their contribution to world science is generally recognized. Yet another serious breakthrough in the field of new knowledge on active intermediate particles of organic reactions is the cycle of papers of V. A. Koptug, V. A. Varkhashch, V. D. Shteyngarts and V. G. Shubin "Fundamental Research of the Structure and Reactivity of Carbon Cations," presented in competition for the 1990 Lenin Prize.

Carbon cations—particles that carry a positive charge on a carbon core—play a decisive role in a wide range of reactions, used in industrial synthesis that relies on coal and petrochemical raw material. A large part of the industrial chemical processes, related to processing of aromatic hydrocarbons to products for production of polymer materials, medicinals, dyes and so on, is based on reactions with participation of these particles.

Processes of regrouping, related to rearrangement of the carbon skeleton of molecules, has been especially intriguing for many years from the viewpoint of theory and has been difficult for quantitative description. Practice requires the skill to predict these frequently very complicated transformations, so as to find simple and economical and recently also "ecological" methods of producing the required compounds. Until recently, not only prediction, but simple explanation of many cases of rearrangement of the skeleton of molecules encountered serious difficulties. This is caused by the fact that several factors ordinarily act immediately and it is very difficult to estimate the role of each of their complex interweaving.

An important feature of the considered cycle of papers is their methodological basis. To overcome the indicated complexity, the authors decided to "clean" the processes to be studied of many perturbing factors. They concentrated during the first phase of the research on study of specially "designed" models, when the carbon cation, as a result of rupture of some and formation of other bonds, is regrouped into a structure identical to the initial structure. This is an extremely interesting type of reactions with infinite repetition of acts of rearrangement of the skeleton. These transformations make no sense from the viewpoint of applied chemistry, since they do not

yield a new product, but make available amazing opportunities in revealing the principles of important chemical reactions.

Scientists have managed to suggest a very simple and clear quantitative description of these processes. They have not only generalized and described a vast amount of experimental material, but have also taken into their hands the guiding thread for finding specific compounds of interest to practice.

The possibility of predicting the main path of these complex, multistep, potentially multiroute transformations of polycyclic terpene compounds in the cycle of papers, offered in the competition for the Lenin Prize is shown. It was also demonstrated that one can, by gradually "freezing" the system, leave the reaction at different intermediate stages when conducting reactions in "superstrong" acids at temperature on the order of minus 100 degrees C, sharply expanding the synthetic capabilities of these transformations. This is especially important to future reorientation of organic chemistry toward renewable plant, primarily wood chemical sources of raw materials.

It should be emphasized that the generalizing theoretical achievements of the authors of the considered cycle of research became possible not only due to the originality of the developed approach, but also as a result of very delicate, clearly oriented experiments using an entire arsenal of physical methods of research. Because of this, it was possible to obtain unique information about the characteristics of the electron and spatial structure of carbon cations, their physical characteristics and tendency toward chemical transformations. A number of new reactions, which are of considerable interest to synthetic chemistry, was discovered, and ecologically "cleaner" processes in place of some now used in the industry of semifinished products for dyes, were proposed.

Like any thorough research of a fundamental nature, the considered cycle of papers generated a number of new interesting directions. The principles revealed for the behavior of carbon cations in molecular regroupings permitted us to lay a bridge toward reactions of aromatic compounds with positively charged agents, very important in the applied sense, and to expand sharply the capabilities of quantitative description of them. No less significant is the construction of the generalized layout of describing the effect of various types of substitutes in positively and negatively charged structures with multiple bonds. It was possible on this path to describe from unified positions very extensive experimental material.

The accumulated experience of using various physical methods of study was embodied in development of effective computer systems for establishing the structure of complex organic compounds on the basis of their molecular spectra.

The papers published by the authors, including five monographs, are well known to specialists in the field of

physical organic chemistry both in the USSR and abroad. On the whole, they are a complete cycle of research on one of the most important types of active intermediate particles with broad theoretical and practical consequences—a cycle which Soviet chemical science can be proud of. We think that one of the authors of this cycle—academician V. A. Koptug—was not accidentally elected president of the International Union of Theoretical and Applied Chemistry in 1987 by the World Scientific Society.

We feel that the research of V. A. Koptug, V. A. Barkhash, V. D. Shteyngarts, and V. G. Shubin is deservedly offered for the competition of the Lenin Prize.

### Shortage of Potassium Permanganate

907M0157B Moscow *RABOCHAYA TRIBUNA* in Russian 2 Mar 90 p 4

[Article by S. Sadoshenko, special correspondent at Saki, Bakhchisaray, Simferopol: "Shortage of Potassium Permanganate"]

[Text] Yesterday the production of potassium manganate or simply potassium permanganate was stopped at the Saki Chemical Plant, the country's only plant.

It is a problem of what to do with the wastes. The chemical plant reprocesses manganese ore and annually produces more than 6,000 tons of potassium manganate, and until the mid-1980's, dumped the wastes—manganese slurries—wherever they wanted to, even in the sea. But scientists of the Simferopol Branch of the Dnepropetrovsk Structural Engineering Institute suggested that these slurries be used—that they be transported to the Bakhchisaray Combine of the Construction Industry and be used as additives to raw material for output of cement.

It was said, tested, and done. The All-Union Scientific Research Institute of Public Health and Toxicology of Pesticides, Polymers and Plastics (VNIIGINTOKS) concluded that the manganese slurries are nontoxic and have no negative effect on the human organism. And the wastes of the Saki Chemical Plant have been used now for several years. True, the quality of the cement made from them, as suggested, was not improved and the quantity was not increased. The only plus is that the slurries do not now pollute the Black Sea coast and the Black Sea.

"Yes, it has become cleaner in Saki but then the manganese is falling on our heads," said the chief physician of the Bakhchisaray rayon Yu. U. Dorofeyev. "The Combine of the Construction Industry is literally flowing with dust. There is at least a ton of discharges per year for each resident of the city. And here is a sum: the residents of Bakhchisaray have 11 percent more diseases than the average oblast level."

"And what about the 'contribution' of manganese?"

"No one has been able to link the diseases to the slurries. The Oblzdravotdel [Oblast Health Department] performed a superficial medical examination of the workers of the combine over 2 days and concluded that the manganese slurries have no negative effect on health. People simply do not believe this."

They also do not believe last year's conclusions of VNIIGINTOKS and the Republic Scientific Hygiene Center of the Ukrainian SSR Ministry of Health that the slurries are nontoxic.

"We were forced to repair the cement furnaces in gas masks. What is this hallucination?" the chief of the mechanical repair shop of the combine V. Lazo is amazed. "And we ourselves have sent the slurries for analysis to Denpropetrovsk State University. They found barium, strontium, iridium and lead in them."

"According to the conclusions of the Ukrainian SSR Ministry of Health, the use of the slurries is considerably more hazardous than the pyrite ash which contains 2.5-fold more heavy metals than those in the slurry. And you use the ash."

Cucumbers were previously grown around the city, but for the past 4 years they only bloom but do not form cucumbers. The pigeons and sparrows have disappeared somewhere, where previously they chirped on the territory of the combine.

"Specialists of NIItsement [Scientific Research Institute of Cement], the Institute of Colloidal Chemistry, of the Chemistry of Water of the Ukrainian SSR Academy of

Sciences, and the Kiev Polytechnical Institute are now conducting ecological examinations outside the department," says the head of the environmental protection section and rational use of natural resources of GlavPEU of the Simferopol Oblispolkom V. Musiyenko. "Its results will be known no earlier than May. But even if they are positive, what is the guarantee that the collective of the combine of the construction industry will believe this examination?"

Yes there is no guarantee and the council of the labor collective of the combine has refused to accept the slurries of the Saki Chemical Plant since 1 March.

I talked with tens of participants of this history and I concluded that it is not the cause of the slurries. If one can prove to the cement workers that the wastes of the chemical plant are nontoxic, tomorrow talk will be about the pyrite ash or some other in favor of discharges of the chemical plant as much as desired. It is simple that, having shut down the country's only potassium permanganate plant, an obscure combine of the construction industry, belonging to Oblagrostroy [not further identified], wants to attract attention to its misfortunes. This collective sees no other way of obtaining several million rubles for purchase of modern scrubbing equipment abroad to transform itself to an ecologically clean plant.

Does group egoism and diktat emerge? One can name it what you will, but I would say differently: this is a sad step of saddened people.

But here is the question: with what will the potassium permanganate be replaced?

UDC 66.074:631.859.13

**Purification of Gases in Ammofos Production**

907M0013B Moscow *KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian* No 9, Sep 89 pp 22-23

[Article by Z. V. Chagina, candidate of technical sciences, Ye. B. Konyukhova, candidate of chemical sciences, F. Ye. Dubinskaya, candidate of technical sciences, A. F. Epshateyn, and S. B. Goncharov]

[Abstract] A study was made of two-phase purification of gases following granulation and drying in the production of fertilizer. The first phase entails the use of a gas absorber sprinkled with phosphoric acid, which traps dust and ammonia. The second phase is implemented by using a cyclone and a second absorber. Optimal conditions are determined for operation of the equipment to achieve maximum effectiveness. Figures 2; References: 2 Russian.

UDC 621.771.8

**Application of Anticorrosion Coatings by Hot Isostatic Pressing**

907M0013F Moscow *KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian* No 9, Sep 89 pp 32-33

[Article by A. P. Boyarinov, Ye. P. Kratt, V. N. Samarov, A. F. Soldatov, and R. A. Khaykin]

[Abstract] The essence of the hot isostatic pressing (HIP) process is the combined effect of temperature up to 2,000 K and an isostatic pressure to 200 MPa. The HIP process is used for anticorrosion cladding of parts with powdered Inconel 625. Further studies are performed with an Ni-Al-Mo-W material for protective coating of sprayer equipment. Parts clad by the HIP process pass factory testing. Figures 2; References: 5 Russian.

**Chemical Waste Disposal in UzSSR**

907M0041A Moscow *SOTSIALISTICHESKAYA INDUSTRIYA in Russian* No 211, 14 Sep 89 p 2

[Article by A. Sarimsakov, inspector of Main Sanitary Epidemiological Administration of UzSSR Ministry of Health under the "Ecological Dramas" rubric: "They Rest On Poisons"; first two paragraphs are boldface *SOTSIALISTICHESKAYA INDUSTRIYA* introduction]

[Text] The chief agronomist of the Uzgarysh sovkhos began right at the start, "Perhaps you could help!"

He related a sad story. Their farm is located on the border with Tashkent. The city is advancing. They also are on the point of reaching the old chemical poison storehouse, and it is full. A no small amount of toxic

substances has accumulated there from time immemorial. Calcium arsenate, for example, has been lying there since as far back as 1946.

Wherever I went, the sovkhos director showed some folders of correspondence with different institutions concerning the removal or destruction of the preparations. Humble appeals do not do any good whatsoever.

The utilization and burial of toxic industrial wastes are the problem of problems today; often it is simply hushed up and not resolved. I think that the unfortunate "experience" of Uzbekistan is also characteristic of other republics and regions. There are few people who understand that even 5 years ago the government of the country issued the corresponding instructions and named the periods of time and departments. It looks as though everything about it has been finished.

I judge the state of affairs concerning this in the republic. Our sovkhos ministry also has decided to take measures. Steps for accomplishing this also have been agreed upon. And also the affair has dragged on. Thus, the sanitary-epidemiological service can file its voluminous correspondence in the fat files of the Uzgarysh sovkhos.

Until we wrote and tried to get an answer, the wave of large and small extraordinary disasters was spreading to practically all oblasts. An accident at the slurry accumulator of the Samarkand Chemical Plant led to catastrophic contamination of the Zerafshan River. Regions of four oblasts remained without drinking water for several days.

Only a miracle protected the Novokokand Chemical Plant from a similar calamity. But there two children who came in contact with seeds infected with phenothiourea (they lay without care in an abandoned place of the kolkhoz imeni A. Ikramov in the Tashkent Oblast), and it was not possible to save them. And did R. Mirzayeva, a 25-year resident of a kolkhoz in the Kitab Rayon of the Kashka-Darya Oblast, think about death when she went to the cabbage field? Preparation BI/589, which had been applied to the rows, killed her. At the same time, tens of thousands of tons of chemical poisons and wastes are stored in dilapidated storehouses and also under the open sky.

It is necessary to act without delay. But nothing is being done. We need only remember the story of butylfos, against which the public and the press, including *SOTSIALISTICHESKAYA INDUSTRIYA*, came out against for many years. By applying all our efforts, we succeeded in banning the use on cabbage fields of the preparation that had led to illnesses and tragic outcomes. But butylfos has remained in the storehouses. And with it, the temptation to use the chemical poison has remained.

The Sanitary-Epidemiological Service of the Lenin July kolkhoz in the Srednechirchikskiy Rayon many times proposed emptying the storehouse of chemical poisons whose use has been suspended. Indeed, it is located all of

a hundred some meters from a kindergarten. Of 124 gin mill disinfectant shops, only 14 meet standards; the remaining ones are located in unadaptable places close to habitations and reservoirs. At the Alimkent gin mill, tests were conducted on the infection of seeds with furadan. The highly toxic preparation, which is suitable for other crops, should not be used for cotton plant seeds. It would seem that it should be sent to those who need it, for example, beet growers, or else used, and there would be no problems. But almost half a ton of the dangerous goods together with ruined seeds lies in an unadaptable place. And where is one to find a storehouse, if they are built decades from now?

Let us take a number of such examples.

This question is in order; why are products of human activity that are a menace not destroyed? And how, where, and by whom should this be done? Abandon the call to all the ministries and departments of the country and take an inventory of toxic wastes. And it will remain a voice crying in the desert. There is no procedure for compiling data and for the technology of utilization. And the main problem is that no one knows where to put dangerous inventories. As for burned out fluorescent lights that are triggered by mercury, is it known where to throw them away?

Therefore we answer the request of one of the Novosibirsk state planning institutes about sites for disposal and burial of the industrial wastes of enterprises of the republic that there are none. There exist only the proposals of our service for their disposal, which were made less than a year ago. We also reply with a refusal to the requests for providing materials on the inventorying of wastes: the enterprises prefer to conceal and artificially lower these data. The penalties of the sanitary epidemiological service are a mosquito bite for them.

The State Agricultural Industry system of the republic alone has accumulated more than 200,000 containers of chemical poison and more than 6,000 tons of toxic substances that are unsuitable and are banned for use. These are only estimates! And they do their dark business, damage health, and take away human life.

Does the sanitary-epidemiological service have the key factors influencing the negligence of farmers? This is a question for the Ministry of Health and for the USSR Peoples Deputies. I think that in the new directives on environmental protection and the sanitary code it is necessary to clearly stipulate the laws and the potentials of the sanitary service to take action against negligent farmers. You don't supply a physician at every storehouse.

The amazing picture accumulates to the absurd. As if blind in daylight, the departments seek the answer from each other to the problems that they themselves must solve. The republic academy of sciences asks us where toxic wastes should be buried. But the responsibility for this lies with the ministries and departments themselves where they are formed. And then academic science is

coexecutor of the work on utilizing wastes and not at all the suppliant. Meanwhile we practically have not obtained a single recommendation.

With the development of all new productions, such requests fall on our desks like autumn leaves. The republic Council of Ministers chose a neutral position, referring everything to our service. And what would be simpler than to look at their own decree of 5-year antiquity and to verify how it has been met. Then it would have to be explained that it isn't so. Gosstroy, Gosstroy, other sizable ministries and departments, and oblast executive committees were made responsible for the poison burial grounds (there are nine of them in all for an enormous territory, and they do not correspond to elementary sanitary standards), for building testing grounds, and for conducting research on the subject of using wastes as secondary raw materials, etc.

And why don't the people responsible make haste to do this, which at every site should then be called a "mess"?

Recently the Novokokand Chemical Plant closed for complete reorganization. The production wastes were threatening the underground source of fresh water feeding the whole area. Alas, this was not the initiative of a department worried about fellow citizens. Public opinion triumphed. This is contrary to leisurely papers of the type, "They heard — they decreed," and to inaction of the people responsible.

Do we really need one more law — about the responsibility for irresponsibility?

UDC 628.3:541:546

#### **Anion Exchange Adsorption of Chromium From Alkaline Wastewater**

*907M0094D Leningrad ZHURNAL PRIKLADNOY KHIMII in Russian Vol 62 No 10, Oct 89 pp 2212-2216*

[Article by N. V. Golovnykh, E. P. Rzhchitskiy, L. L. Zavyalova, and V. I. Lipskaya, Irkutsk Branch, All-Union Scientific Research Institute of the Aluminum, Magnesium, and Electrode Industry; Irkutsk State Scientific Research Institute of Rare Metals]

[Abstract] In order to measure the selectivity of 14 anion exchange resins of varying alkalinity with respect to chromium-containing solutions, (which may be useful in wastewater purification), 1-year-duration static experiments were conducted. Determination of static exchange volumes and distribution coefficients showed that while at pH 12.5 highly alkaline resins ( $pK_B$  1-3) adsorbed more Cr(VI), at pH 9.5 resins of moderate ( $pK_B$  3-5) and high alkalinity adsorbed about equal amounts of the chromium ion. Low alkalinity resins ( $pK_B$  5-8) and the ampholyte ANKF-80 had small but measurable adsorption of Cr(IV). Even a very low alkalinity resin, AN-1, whose  $pK_B$  is above 8, adsorbed Cr(IV) at concentrations an order of magnitude greater than the solution concentration. Dynamic column adsorption experiments were

conducted on three resins, one (AV-17-8) highly alkaline, and two (EDE-10P and AN-31) of moderate alkalinity. After 10 L of chromium-containing solution (pH 12.4) was passed through the columns, the solutions were regenerated with 2 L of 0.2 N KOH. Three cycles were conducted. While AV-17-8 had a higher working volume with regard to chromium, EDE-10P had the best performance properties. The kinetics of Cr(IV) adsorption on the low-alkalinity sorbent VP-1PA were studied. The data indicate that the initial adsorption period, at pH

9.5, is diffusion controlled. At pH 12.5 diffusion is complicated by the actions of the hydroxide ion, so gel filtration mechanisms are involved. One may conclude that in alkaline media low-alkalinity ion-exchange resins may adsorb chromium ions in amounts exceeding their ion-exchange volumes at the given pH. Moderate-alkalinity macroporous resins can be successfully used together with high-alkalinity resins to purify alkaline wastewater from Cr(IV). Figures 2; references 8: Russian.

UDC 539.216.2

**Change in 100 Surface Structure of GaAs Upon Precipitation of Gold**

907M0011A Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 25 No 9, Sep 89 (manuscript received 29 Jul 87) pp 1422-1425

[Article by T. A. Bryantseva, V. Yu. Vinnichenko, G. G. Dvoryankina, Ye. B. Sokolova, and Ye. O. Unevich, Institute of Radio Engineering and Electronics, USSR Academy of Sciences]

[Abstract] A study is made of the changes in structure and composition of the [100] surface of GaAs in the initial stages of growth of gold films as a function of the method of preliminary processing. The GaAs specimens used were epitaxially grown layers with an electron concentration of  $10^{14}$ - $10^{17}$  cm<sup>-3</sup> plus plates cut from a single crystal with  $M = 10^{18}$  cm<sup>-3</sup>. It is found that in the early stages of precipitation of gold under an ordinary vacuum, the structure of the surface layer of the GaAs changes. A defective single-crystal GaAs layer is formed, usually with a hexagonal lattice structure. If an oxide layer is present, precipitation of gold results in the formation of polycrystalline GaAs, whereas with looser or thin oxide layers a mosaic GaAs single-crystal structure is formed. These changes determine the structure and composition of the gold films. References 7: 5 Russian, 2 Western.

UDC 535.361:539.24

**Influence of Microstructure of Polycrystalline Specimens of Zinc Sulfide on Their Optical Properties**

907M0011B Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 25 No 9, Sep 89 (Manuscript received 31 Jul 87) pp 1430-1433

[Article by A. N. Bryzgalov, B. M. Slepchenko, V. V. Musatov, B. P. Virachev, and G. I. Romanova, Chelyabinsk Pedagogic Institute]

[Abstract] A study is presented of the variation in the optical properties of polycrystalline ZnS-based materials as functions of grain structure characteristics. Transmission spectra of specimens were measured at 2-15  $\mu$ m. Measurements performed on two specimens with different grain structures revealed the significant influence of the grain structure on transmission of the specimens in the IR area, a result of the increase in scattering on irregularities when the dimensions of the irregularities and wave length of the radiation coincide. Figures 4; References 5: 4 Russian, 1 Western.

UDC 536.48.433

**Thermodynamic Properties of ZnGa<sub>2</sub>Se<sub>4</sub> and ZnIn<sub>2</sub>Se<sub>4</sub> Semiconductors and Solid Solutions Based on Them at Low Temperatures**

907M0011E Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 25 No 1, Sep 89 (Manuscript received 22 Jan 87) pp 1449-1453

[Article by R. K. Veliyev, K. K. Mamedov, G. G. Guseynov, F. M. Seidov, Physics Institute, AzSSR Academy of Sciences]

[Abstract] Results are presented from a study of the heat capacity of the semiconductors ZnGa<sub>2</sub>Se<sub>4</sub> and ZnIn<sub>2</sub>Se<sub>4</sub> and their solid solutions at 5- 300 K. A state diagram of the system ZnGa<sub>2</sub>Se<sub>4</sub>-ZnIn<sub>2</sub>Se<sub>4</sub> is constructed and indicates unlimited solubility in the solid and liquid states. Figures 4; References: 5 Russian.

UDC 621.315.592:535.376+546.621'171

**Optical Properties of Epitaxial Layers of Aluminum Nitride Doped With Oxygen**

907M0011F Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 25 No 9, Sep 89 (Manuscript received 11 Jun 87) pp 1477-1481

[Article by V. F. Veslov, A. V. Dobrynin, G. A. Nayda, P. A. Pundur, E. A. Slotseniyetse, and Ye. B. Sokolov, Moscow Institute of Electronic Technology; Latvian State University imeni P. Stuchka]

[Abstract] A study is made of the optical properties of epitaxial AlN layers to which oxygen is introduced during the growth process. The epitaxial layers were produced on sapphire substrates by pyrolysis of ammonia complexes of aluminum halides. Auger-electron and IR spectroscopy are used to study the compositions of single crystal layers up to four  $\mu$ m thick. The intensity of cathode luminescence of the layers varies nonmonotonically as a function of oxide concentration. The intensity of the 3.3-eV band is minimal at  $1-x = 10^{-5}$ - $10^{-4}$  mol parts. Figures 5; References 11: 4 Russian, 7 Western.

UDC 546.668'22'19

**Paramagnetism of Arsenic Sulfide Glasses With Ytterbium**

907M0011G Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 25 No 9, Sep 89 (Manuscript received 24 Jul 87) pp 1541-1543

[Article by A. I. Mamedov, T. M. Ilyasov, and F. G. Akperov, Special Design and Technology Office of Complex Processing of Mineral Raw Materials With Experimental Production, AzSSR Academy of Sciences, Azerbaijan State University imeni S. M. Kirov]

[Abstract] EPR spectra are used to determine the reasons for the variable valence of ytterbium in glasses. EPR spectra were measured at atmospheric pressure and temperatures from 77 to 300 K. It is found that in sulfide glasses there are two types of paramagnetic centers. The nature of the centers formed in impurities has a significant influence on the formation of structure defects and the ionic nature of the chemical bonds between arsenic and sulfur. The glasses studied have structural defects with positive electron correlation energy. Paramagnetic centers result from the optically induced paramagnetism of neutral atomic defects and indicate a significant variation in close-order parameters of the  $\text{Yb}^{2+}$  ions that occupy the position of modifiers in the glass. Figure 1; References: 5 Russian.

UDC 537.525.1

### Ozone Synthesis in a Pulsed Independent Discharge

907M0073B Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 10, Oct 89 (manuscript received 11 Jun 88) pp 2782-2785

[Article by A. B. Pravdin and V. I. Gibalov, Moscow State University imeni M. V. Lomonosov]

[Abstract] Ozone is currently produced industrially in a so-called barrier discharge reactor. Research shows that the following processes take place in sequence: breakdown of the discharge interval into individual microdischarge channels at initiation, electron drift and proliferation in microdischarges, and dissociation of molecular oxygen by electron shock resulting in ozone synthesis in the channels. Diffusion and gas drift in the discharge zone evens out the ozone concentration in the exit gas. Except for certain stipulations, the charge in the barrier discharge determines the ozone yield, and the magnitude of this charge in turn depends on the size of the discharge gap and the power characteristics. For these reasons, it is difficult to interact with the kinetic characteristics of the electrons during the first stage in barrier discharge. These difficulties may now be circumscribed to some extent by using conducting electrodes with a nanosecond pulse interval. In the present work an experimental study of ozone synthesis in an independent pulsed discharge reactor shows that voltage is not the determining factor in ozone yield. The results further indicate that conditions exist where bulk independent discharge becomes a competitive plasmachemical means of ozone synthesis. Figures 4; references 8: 4 Russian, 4 Western.

UDC 537.525.1

### Ozone Synthesis in Pulsed Nonindependent Discharge

907M0073C Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 10, Oct 89 (manuscript received 11 Jul 88) pp 2785-2789

[Article by A. B. Pravdin and V. I. Gibalov, Moscow State University imeni M. V. Lomonosov]

[Abstract] The study of ozone synthesis in a barrier pulsed independent discharge is encumbered by the large discharge gradients throughout the discharge interval. It is therefore more convenient to study plasmachemical synthesis under such conditions where the electrical field excitations can be reduced to a minimum, e.g., a low-pressure nonindependent discharge. In the present work some experimental results of electrosynthesis of ozone in this type of discharge are presented. Direct current was applied to an annular electrode enclosing a preionizer electrode. A high voltage pulse of 25 ns was applied to the preionizer electrode to provide the independent discharge conducted in pure oxygen at 38 torr pressure. In contrast to independent discharge, a distinct relationship exists between ozone yield and the potential of the applied electrical field. Figures 5; references 5: 3 Russian, 2 Western.

UDC 541.13

### Barrier Discharge in High-Permeability Dielectrics. Part II. Ozone Synthesis

907M0073D Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 4, Oct 89 (manuscript received 1 Sep 88) pp 2804-2807

[Article by V. I. Gibalov, V. Ye. Volodin, and V. G. Samoylovich, Moscow State University imeni M. V. Lomonosov]

[Abstract] Research on ozone synthesis in a barrier discharge has almost always been conducted with dielectrics with a permeability of 10 or less. The main goal in such research was to increase the efficiency of ozone synthesis. Theoretically, the capacity (and therefore the productivity) of an ozonator may be increased by raising the frequency of the electrical current or by using a higher value dielectric. In the present work a study was made of the properties of a barrier discharge and ozone synthesis using ceramic dielectrics ranging from several units to 1,000. The results show that using high-permeability dielectrics at 50 Hz makes it possible to attain electrical power comparable to that obtained with 600-1,500 Hz. The efficiency of ozone synthesis under these conditions depends greatly on the discharge gap. If the latter is small, the efficiency is similar to that of conventional ozonators. Figures 3; references 6: 2 Russian, 4 Western.

UDC 539.196:546.2

### Interatomic Potential and Equation of State for Diamond-Like Semiconductors

907M0091A Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 22 Aug 88) pp 2943-2947

[Article by M. N. Mazomedov, Geothermal Problems Institute, Makhachkala]

[Abstract] The Lennard-Jones (a-b) interatomic potential is used to study various physical properties of diamond, silicon, and germanium. The values a and b are parameters for remote potential and rigidity and are determined by comparing physical property data obtained experimentally with calculated values. However, some published potential parameters show discrepancies among themselves for the same element, thus requiring a more correct interrelated determination of all four parameters in the Lennard-Jones equation. In the present work a method is proposed for determining all four parameters for diamond, silicon, germanium, and tin. The resulting parameters, when used to calculate thermodynamic properties, yielded better agreement with experimental data than that of the published parameters. Figure 1; references 14: 10 Russian, 4 Western.

UDC 541.183

#### Localized and Delocalized Adsorption of Inert Gases With Zeolites

907M0091B Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11 Nov 89, (manuscript received 22 Jul 88) pp 2969-2972

[Article by A.P. Golikov, V. A. Avramenko, and V. Yu. Glushchenko, Chemistry Institute, Vladivostok]

[Abstract] So far, most molecular-statistical accountings of adsorption in zeolites have been carried out under rarefied conditions, although adsorption systems having high particle density could possess unexpected properties because a strong intermolecular reaction can result in significant changes in the properties of the adsorbed substance. In the present work a molecular dynamics method was employed to study the adsorption of argon and krypton on zeolite 5A. An algorithm was used in a numerical experiment that made it possible to estimate the localization sites within the zeolite cavities and the transitions between different localization regions. It was demonstrated that in the event of high-cavity filling, the transition of localized adsorption to delocalized adsorption takes place within a narrow temperature interval. Figures 2; references 4: 2 Russian, 2 Western.

UDC 541.128:541.183

#### Effect of Mechanical Activation on Adsorptive and Catalytic Properties of SVK-Zeolites

907M0091C Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 19 Sep 88) pp 2973-2977

[Article by L. I. Sivirilova, L. M. Koval, and A. V. Vosmerikov, Tomsk State University imeni V. V. Kuybyshev]

[Abstract] The possible alteration of the structure of crystalline substances placed under high mechanical loads evinced interest in studying fine and superfine

milling processes. During mechanical activation, the free energy of milling a substance increases as a result of both an increase in specific surface and deformation with partial crystal lattice breakdown and formation of various structural defects. A substance subjected to this type of action could thus have exceptionally high chemical reactivity. In the present work a study was made of the effects of mechanical activation on the porous structure, adsorption, and catalytic properties of SVK-Zeolites in the conversion of methanol to hydrocarbons. Milling was found to affect not only the porous structure but also the surface acidity, which in turn affects the catalytic properties of the zeolite. The change in surface acidity and the ensuing catalytic properties are functions of the duration of activation. Figures 5; references 8: 6 Russian, 2 Western.

UDC 541.121:548.53

#### Effect of Pressure and Temperature on Density and Size of Dislocations

907M0091D Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 8 Jul 88) pp 3070-3072

[Article by V. B. Fedoseyev, Institute of Machine Science imeni A. A. Blagonravov, Gorkiy Branch]

[Abstract] According to a thermodynamic analysis made within the framework of the dislocation theory, the equilibrium density of dislocation in a crystal diminishes to extinction. Although this analysis contradicts observation, it still serves as the basis for a fundamental conclusion of the nonequilibrium of dislocation. In the present work an analysis of the size and density of dislocation in crystals was made within the framework of equilibrium thermodynamics, and the behavior patterns of dislocation structure in crystals with changing temperatures and hydrostatic pressures were examined. References 8 (Russian).

UDC 546.763

#### Effect of Doping on Crystallization and Relaxation Temperature Changes in Amorphous Boron-Containing Melts

907M0091E Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 14 Mar 89) pp 3074-3076

[Article by L. A. Reznitskiy, Moscow State University imeni M. V. Lomonosov]

[Abstract] In a previous work a thermochemical bond model for transition metal borides was presented that makes it possible to approximate the enthalpy of formation of the borides. The conceptual approach is based on the quantization of energy inequalities of coexisting bonds. Enthalpies of formation of the borides may be utilized to explain changes in crystallization temperatures in amorphous melts when doped with various

substances. In the present work the concurrence of experimental data with that obtained from the model was confirmed for changes in crystallization and relaxation temperatures of transition metal borides. References 5: 2 Russian, 3 Western.

UDC 533.66.063

#### Laws Governing Diffusion in Me-MeC System Melts

907M0091F Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 pp 3076-3078

[Article by F. M. Khusnetdinov, V. V. Leonov, I. G. Kuzmina, and A. V. Yakovleva]

[Abstract] Diffusion in metals is the basis for many processes that determine the properties of materials. As the compositions of alloys become more and more complex, the need for understanding the laws governing this process becomes more and more acute. However, diffusion in multicomponent and multiphase systems has been less thoroughly studied than have autodiffusion and diffusion in binary systems. Low reproducibility of results is characteristic for crystallization processes in alloys of the type  $\gamma/\gamma'$ -MeC. Diffusion of alloy components is one of the physical parameters that determine the crystallization rate. However, a study of such alloys is encumbered by their high melting points and poor wetting of ceramic capillaries. In the present work a method is presented for studying the diffusion of tungsten, niobium, and carbon in the vicinity of the solidus and liquidus lines of an alloy doped with Mo, V, Hf, Cr, Co, and Al. Tungsten, niobium, and carbon were selected because they form the basis for reinforcing the carbide phase in the alloy, thereby limiting the crystallization rate. The procedure may be used to determine diffusion coefficients of elements in heat-resistant nickel alloys. Figures 2; references 2 (Russian).

UDC 541.14

#### Physicochemical, Optical, and Photoelectric Properties of Organic Semiconductor Perylene Bordeaux

907M0091G Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 27 Dec 88) pp 3081-3084

[Article by M. I. Fedorov, S. V. Maslenikov, V. A. Shorin, and Sh. R. Melkonyan]

[Abstract] The growing interest in research on organic semiconductor solar energy cells resulted in the synthesis of new organic semiconductor materials. Especially interesting are the p-type semiconductors metal phthalocyanines, merocyanines, and n-type semiconductors derived from perylene. The metal phthalocyanines and merocyanines have been well studied, and solar energy cells have been made from them, but perylene bordeaux remains unknown as an organic semiconductor. In the

present work a study of its properties shows that perylene bordeaux pigment has an n-type conductivity of  $10^{-8}$  Ohm  $\text{cm}^{-1}$  in a "sandwich" cell, a carrier mobility of  $0.9 \times 10^{-3} \text{ cm}^2(\text{Vsec})^{-1}$ , and a 0.8-eV activation energy. Absorption spectra of the perylene bordeaux film lie in the interval 400-600 nm. A solar energy cell ( $\text{SnO}_2/\text{CuPc/BTs/Ag}$ ) that generated a photo-emf of 0.47 volts after radiation through  $\text{SnO}_2$  was prepared. The extinction current was  $2.1 \times 10^{-5} \text{ amp-cm}^{-2}$ , the fill factor amounted to 0.19, and the maximum efficiency was 0.33 percent. Figures 2; references 9: 2 Russian, 7 Western.

UDC 661.183[546.8+546.226]

#### Features of Titanium and Scandium Sorption With Aminophosphonic Ampholyte Gel

907M0091H Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 26 Jan 89) pp 3092-3094

[Article by S. A. Yurlov, A. L. Smirnov, G. M. Voldman, and O. A. Davidenko, Forest Technology Institute imeni Lenin Komsomol, Sverdlovsk; Fine Chemical Technology Institute imeni D. I. Mendeleev, Moscow]

[Abstract] Phosphorus-containing ionites are known to have high capacities at elevated temperatures. However, data on the kinetics of titanium and scandium sorption under these conditions are lacking. Also, the surface area of a sorbent is known to be a major factor in the overall capacity of an ionite in certain cases of polyvalent metal leaching. A study of the sorption kinetics of titanium and scandium with aminophosphonic ampholyte ANKF-2 from sulfate solutions shows that the sorption takes place at the ionite particle surface. Raising the temperature of the process increases the effective internal diffusion coefficients while maintaining the same thickness of the absorbing layer. Figures 2; references 5 (Russian).

UDC 546.791.4 141:[539.27+539.193+539.194]

#### Structure of Uranium Tetrabromide Molecules

907M0091I Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 16 Jan 89) pp 3094-3097

[Article by Yu. S. Yezhov, V. I. Bazhanov, S. A. Komarov, M. S. Popik, V. G. Sevastyanov, and F. Yuldashev, High Temperatures Institute, Moscow]

[Abstract] Although the molecular structure of uranium tetrabromide has long attracted the interest of researchers, existing information in the literature is very fragmented. Specifically, gas electronography shows that this compound probably has a distorted tetrahedral configuration with  $C_{2v}$  symmetry. Valence angles were estimated at  $90(3)^\circ$  and  $105(3)^\circ$  for  $\alpha(\text{Br}^+\text{U}^-\text{Br})$  and  $\beta(\text{Br}^+\text{U}^-\text{Br})$ , respectively. A broad band with a maximum at  $230 \text{ cm}^{-1}$  was detected with gas phase IR-spectroscopy. In the present work gas electronography shows that the

geometric configuration of this molecule has  $C_{2v}$  symmetry with the parameters ( $T_{\text{exper}} = 900 \text{ K}$ ),  $R(\text{U}Br) = 2.68(1)$  angstroms, and  $\beta(\text{Br}^{\text{U}}\text{Br}) = 100(1)^\circ$ . Frequency values for vibrational spectra coincide favorably with the position of the band maximum in IR-spectra, which makes it possible to recommend these values as being sufficiently accurate. Figure 1; references 14: 10 Russian, 4 Western.

UDC 536.7

### Thermodynamic Properties of $\text{Mn}_2\text{Mo}_3\text{O}_8$ and $\text{MnMoO}_4$

907M0091J Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 6 Jan 89) pp 3105-3108

[Article by F. Glate, I. S. Sukhushina, and I. A. Vasilyeva, Moscow State University imeni M. V. Lomonosov]

[Abstract] Although there are sufficient references in the literature on the thermodynamic properties of phases in Me-O systems, there is considerably less information available on the phase thermodynamics of triple systems Me-Me'-O. In the present work emf through a solid electrolyte with separated and nonseparated reference electrodes was used to determine partial thermodynamic properties of the title compounds in reactions with oxygen at 1,100-1,400 K. Formation entropies and other thermodynamic functions were determined for  $\text{MnMoO}_4$  and  $\text{Mn}_2\text{Mo}_3\text{O}_8$  at 1,300 K and 298 K. Figures 2; references 8: 5 Russian, 3 Western.

UDC 541.17+546.46.72.11

### Kinetics of Formation of Triple Hydride $\text{Mg}_2\text{FeH}_6$ From Elements

907M0091K Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 7 Feb 89)

[Article by I. G. Konstanchuk and A. A. Stepanov, Solid-State Chemistry and Minerals Refining Institute, Novosibirsk]

[Abstract] Triple hydrides are synthesized from systems not having hydride-forming intermetallic compounds by the reaction of two hydrides or a binary hydride with a metal at high temperatures. It was previously demonstrated that when the hydrogen equilibrium pressure over the title triple hydride is less than that over magnesium hydride and that under those conditions where magnesium does not form, it is possible to synthesize the triple hydride directly from its elements. The kinetics of this reaction was studied in the present work, and a topochemical model of the reaction "solid + solid + gas" is presented. The reaction is based on nuclei formation of the hydride phase within a layer adsorbed at the hydrogen interface.

UDC 541.124:546.11.02.2.3:537.312.62

### Catalytic Activity of Superconducting Ceramic of Type Y-Ba-Cu-O in H-D Exchange Reactions of Molecular Hydrogen

907M0091L Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 63 No 11, Nov 89 (manuscript received 15 Jun 89) pp 3135-3137

[Article by V. S. Parbuzin and V. V. Gulyants, Moscow State University imeni M. V. Lomonosov]

[Abstract] A study was made of the catalytic activity of the high-temperature superconducting Y-Ba-Cu-O oxide ceramic in a simple deuterium-hydrogen exchange reaction model. This research is significant because the activity of such a catalyst in an H-D exchange reaction can be used to gauge its usefulness in reactions requiring activation of molecular hydrogen. The studies could also aid in understanding the nature of high temperature superconductivity. Chromatography at 350-450 K and 182,500 Pa hydrogen pressure was used to determine reaction rate constants. The activation energy of the process is  $58 \pm 2$  kJ/mol. The Bonhoeffer-Farkas mechanism, in conjunction with adsorption on copper atoms in the vicinity of oxygen vacancies, may be useful. Figure 1; references 11: 2 Russian, 9 Western.

UDC 661.961.9

### Kinetic Principles of Decomposition of Sulfuric Acid on Aluminopalladium Catalyst

907M0094A Leningrad ZHURNAL PRIKLADNOY KHIMII in Russian Vol 62 No 10, Oct 89 pp 2183-2185 [MS Received 1 Feb 89]

[Article by A. F. Petropavlovskiy, V. N. Kovalev, V. Ye. Sorko, and A. V. Forsov, Leningrad Technical Institute imeni Lensovet] txt

[Abstract] Due to its use as part of the sulfuric acid thermochemical splitting of water, the decomposition of sulfuric acid on 0.24-0.4 mm diameter particles of the APK-2 aluminopalladium catalyst was studied in a laboratory flow-through reactor at 1,000-1,200 K and 3.0 MPa. The Hougen-Watson method was used to determine kinetic principles. Differentiation and extrapolation by the Langmuir method of the dependence of the degree of decomposition of sulfuric acid on contact time with catalyst at 0.3-2.5 MPa indicated that the initial rate is maximal at 1.2-2.0 MPa. The dependence of the degree of decomposition on contact time can be described by only one equation. A system of nonlinear equations was obtained by integrating the kinetic equation and substituting experimentally obtained values into it. Coefficients of Arrhenius equations were calculated for the reaction rate and adsorption coefficients. Activation energy for sulfuric acid decomposition was found to be 154 kJ/mol, similar to that for analogous catalysts. Activation energy for sulfur trioxide decomposition to sulfur dioxide was 60 kJ/mol. Reagent adsorption coefficients increased with temperature due to a

reversible chemical reaction with the catalyst. This is confirmed by the high activation energies for adsorption. Figures 3; references 7: 5 Russian, 2 Western.

UDC 541.182:541.18:546.73

**Indicator Properties of Covalent Silicates Obtained by Introducing Cobalt Salts Into Silica Sol, Silica Gel, and Silica Zerogel**

907M0094B Leningrad ZHURNAL PRIKLADNOY KHIMII in Russian Vol 62 No 10, Oct 89pp 2190-2194

[Article by N. G. Belotserkovskiy, D. P. Dobychn, G. M. Kesareva, V. I. Malkiman, N. G. Tymenko, and V. M. Shamrikov]

[Abstract] The sodium form of concentrated aqueous silicic acid or sodium silicate was passed through ion-exchange resin KV-2. The fraction at pH 2.9 was combined with cobalt chloride to obtain a pure, stable sol. Silica gel was formed from the sol without cobalt chloride by evaporation of water at 80° followed by gel formation at room temperature in an open vessel over a period of 15-20 days. Silica zerogel was obtained by thermal treatment of the sol at 160° for 4 hours. All three forms were produced in large and small particle size variants to yield a total of six samples. A solution of cobalt chloride was added to each and ion-exchange equilibrium achieved in 3-7 days. The quantity of ion-exchange sorbed cobalt per unit of silica surface was greatest in the sol and least in the zerogel. This reflects the amount of silanol groups spatially accessible to the solvated cobalt ion. Physical sorption of cobalt was greater in large particle size samples than in those of small particle size, regardless of form. The data indicate that, in addition to chemically and physically sorbed cobalt, small crystals of cobalt salts are deposited in the pores of the silicates during evaporation. Study of the indicator properties of the samples demonstrated that small-particle silicates had a color change region at lower humidities than did large-particle samples. The highest result, 35-50 percent relative humidity, was obtained for the large-particle sol, while the lowest result, 0.1-10 percent relative humidity, was obtained for the small-particle zerogel. One may conclude that intensely colored indicators for low humidity are best prepared by direct impregnation of small-pore silica zerogel. Indicator properties are a complex function of cobalt ion type and silicate properties. Figures 3; references 9: 8 Russian, 1 Western.

UDC 541.124:546.31

**Kinetics of Adsorption of Alkali Metal Cations on Amorphous Tin Phosphate**

907M0094C Leningrad ZHURNAL PRIKLADNOY KHIMII in Russian Vol 62, No 10, Oct 89 pp 2199-2202 [MS Received 26 May 88]

[Article by G. I. Smirnov, A. S. Chernyak, O. N. Kostromina, A. A. Ogorodnikova, and B. G. Shpeyzer, Irkutsk State University]

[Abstract] The kinetics of sodium, potassium, and cesium adsorption onto amorphous tin phosphate were studied by using the isoconcentration method and an improved automatic titrator at constant pH and temperature. Smaller sorbent particle size resulted in a greater rate and extent of adsorption. This indicates that diffusion is the rate-limiting step. The rate of ion exchange after interrupting sorbate-sorbent contact for 2 hours is greater than for noninterrupted adsorption, which also demonstrated diffusion control. Studies of adsorption at various temperatures from 15 to 45°C revealed a biphasic process with a faster initial phase. This is probably due to inhomogeneous sorption sites. Coefficients of diffusion were determined. All coefficients increased with temperature due to increased site accessibility and greater ease of ion dehydration. Coefficients decreased as the ion radius increased. Activation energy was not related to the diffusion coefficient. The results obtained are consistent with those previously reported for zirconium and titanium phosphate sorbents. Figures 3; references 9: 8 Russian, 1 Western.

UDC 543.27;661.82

**Physicochemical Bases for Obtaining Highly Stable Adsorbents for Recovery of Platinum Group Metals**

907M0094E Leningrad ZHURNAL PRIKLADNOY KHIMII in Russian Vol 62 No 10, Oct 89 pp 2216-2221

[Article by N. V. Trusov, G. I. Grin, K. P. Vernigora, A. Ya. Loboyko, L. N. Vondarenko, and I. P. Gayduk, Kharkov Polytechnical University]

[Abstract] A highly stable adsorbent was produced from calcium carbonate and aluminum hydroxide by semidry molding, and the physicochemical principles of its production were studied. Mechanical compression strength was maximal for samples initially compressed at 120 MPa. Gas evolution during molding lowered the overall stability as compared with previously reported results. The dependence of mechanical strength on calcium carbonate content can be shifted to higher maxima by increasing the mold pressure. This is due to compensation for low diffusion rates. Increasing the agglomeration temperature had a negative effect on stability, with a local stability maximum at 1,283 K due to nonstoichiometric formation of  $3\text{CaO} \cdot 5\text{Al}_2\text{O}_3$ . The data indicate that it is possible to produce an effective sorbent for the recovery of platinum group metals by using calcium carbonate and aluminum hydroxide. During use the sorbent undergoes self-hardening due to solid-phase interactions. The sorbent developed achieved 80 percent relative recovery of platinoids when the sorbent initially contained 2.3 mass percent platinum. Platinum in the sorbent exists as both  $\text{Ca}_4\text{PtO}_{62}$ . Figures 5; references 12: 1 Polish, 1 Czechoslovak, 9 Russian, 1 Western.

UDC 547.312.62:541.124.16:546.562:546.431

**Phase Formation Sequence in Solid Phase  
Synthesis of  $Y_2O_3$ -BaO-CuO System Compounds**

907M0094F Leningrad ZHURNAL PRIKLADNOY  
KHIMII in Russian Vol 62 No 10, Oct 89 pp 2241-2245

[Article by O. G. Chigreva, V. I. Shitova, G. A. Mikirticheva, L. Yu. Grabovenko, S. K. Kuchayeva, D. P. Romanov, and R. G. Grebenshchikoye, Institute of Silicate Chemistry imeni I. V. Grevenshchikov, USSR Academy of Sciences]

[Abstract] The phase formation sequence was studied between 550°C and 1,100°C in air by using  $Y_2O_3$  and CuO, with either  $BaCO_3$ , BaO, or  $Ba(NO_3)_2$  overall stability as compared with previously reported results. The dependence of mechanical strength on calcium carbonate content can be shifted to higher maxima by increasing the mold pressure. This is due to compensation for low diffusion rates. Increasing the agglomeration temperature had a negative effect on stability, with a local stability maximum at 1,283 K, due to the nonstoichiometric formation of  $3CaO \cdot 5Al_2O_3$ . The data indicate that it is possible to produce an effective sorbent for recovery of platinum group metals by using calcium carbonate and aluminum hydroxide. During use the sorbent undergoes self-hardening due to solid-phase interactions. The sorbent developed achieved 80 percent relative recovery of platinoids when the sorbent initially contained 2.3 mass percent platinum. Platinum in the sorbent exists as both  $Ca_4PtO_{62}$ . Figures 5; references 12: 1 Polish, 1 Czechoslovak, 9 Russian, 1 Western.

UDC 625.359.3:669.24

**Thermal Stability of Nickel Electrolytic  
Composites**

907M0094G Leningrad ZHURNAL PRIKLADNOY  
KHIMII in Russian Vol 62 No 10, Oct 89 pp 2364-2366  
[MS received 10 Nov 88]

[Article by V.M. Nagirnyy and R.D. Apostolova]

[Abstract] The behavior of nickel composites, particularly those containing 0.1-0.3 percent manganese with one- and two-component disperse-phase heatproof metal components, was studied under conditions of high-temperature heating. At annealing temperatures up to 800°C, the composites experienced rapid softening analogous to that seen with the pure matrix materials. From 800°C to 1,200°C the stability limit was almost constant, with the Ni-Mn overall stability compared with previously reported results. The dependence of mechanical strength on calcium carbonate content can be shifted to higher maxima by increasing the mold pressure. This is due to compensation for low diffusion rates. Increasing the agglomeration temperature had a negative effect on stability, with a local stability maximum at 1,283 K due to the nonstoichiometric formation of  $3CaO \cdot 5Al_2O_3$ . The data indicate that it is possible to produce an

effective sorbent for recovery of platinum group metals by using calcium carbonate and aluminum hydroxide. During use the sorbent undergoes self-hardening due to solid-phase interactions. The sorbent developed achieved 80 percent relative recovery of platinoids when the sorbent initially contained 2.3 mass percent platinum. Platinum in the sorbent exists as both  $Ca_4PtO_{62}$ . Figures 5; references 12: 1 Polish, 1 Czechoslovak, 9 Russian, 1 Western.

UDC 546.57

**Production of High-Purity Cuprous Chloride**

907M0095A Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 6, Nov-Dec 89  
pp 62-64 [MS Received 31 Mar 89]

[Article by V. N. Zagorodnev, N. V. Lichkova, and V. Yu. Nad, Institute for Technological Problems in Microelectronics and High-Purity Materials, USSR Academy of Sciences, Chernogolovka]

[Abstract] A three-stage method for the stringent purification of cuprous chloride was developed. The starting material, "pure"-grade CuCl, was first treated with ammonium chloride in order to convert oxygen-containing impurities to chlorides. Optimal conditions for this step were the use of 5-10 mass percent ammonium chloride and maintenance of the reaction at 400-450° for 1.0-1.5 hours, followed by heating of the melt to 600-650° for 1 hour. During the second heating stage,  $CuCl_2$  decomposes to CuCl. IR spectral analysis of the results of this purification stage indicated that oxygen-containing anionic impurities were reduced to a level below  $1 \times 10^{-3}$  mass percent. EPR showed that Cu(II) levels were below  $1 \times 10^{-4}$  mass percent. Zonal fusion in an evacuated quartz container gave colorless, transparent ingots of CuCl with high optical homogeneity and stability. The impurity content was below the detection limit of  $5 \times 10^{-4}$  mass percent. This was confirmed by mass spectral analysis of the reduced copper produced from the purified CuCl. Figures 1; references 9: Russian.

UDC 546.57

**Stringent Purification of Cuprous Iodide Using  
Zonal Recrystallization**

907M0095B Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 6, Nov-Dec 89  
pp 65-68 [MS Received 31 Mar 89]

[Article by V. N. Zagorodnev and N. V. Lichkova, Institute for Technological Problems in Microelectronics and High-Purity Materials, USSR Academy of Sciences, Chernogolovka]

[Abstract] The behavior of Fe, Mn, Mg, Pb, Cr, Ni, and Bi impurities during the directed crystallization of cuprous iodide was studied, and their distribution coefficients were evaluated to measure the effectiveness of zonal recrystallization in the purification of CuI. The directed crystallization was conducted in a quartz

ampule at pressures no greater than 1.0 Pa, without seeding by using heater translation rates of 1.25, 2.50, and 6.25 mm/hr. Emission spectroscopy was used to measure the change in intensity of spectral lines along the ingot, from which distribution coefficients were calculated. Results were extrapolated to the zero translation rate to obtain equilibrium distribution coefficients. It was observed that the coefficients were only weakly dependent on the translation rate, which indicated that zonal recrystallization could be conducted at relatively high rates. Zonal fusion of CuI was conducted at 25 mm/hr. Relatively high levels of silicon and silicates were found in the purified CuI due to interaction with the container. All other oxygen-containing impurities were found to be below the detection limits of  $1 \times 10^{-3}$  mass percent. The data indicate that zonal recrystallization may be used to produce CuI with levels of Fe, Pb, Sn, Cr, Ni, Bi, Mn, and Al below  $1 \times 10^{-4}$  mass percent. Treatment with HI solution at 45-55°, recrystallization from HI solution, and particularly vacuum thermal treatment at 650° and pressures below 1 Pa for 2 hours were effective in lowering impurity levels. The recommended purification procedure is treatment with HI solution followed by drying, dynamic vacuum fusion, and zonal fusion. References 4: Russian.

UDC 661.847.932.1:539.213.535.345.1-15

#### Certain Optical Properties of High-Purity Vitreous Zinc Chloride

907M0095C Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 6, Nov-Dec 89 pp 69-73 [MS received 7 Jul 89]

[Article by G. G. Debyatykh, A. D. Bulanov, and V. A. Shipunov, Institute for the Chemistry of High-Purity Substances, USSR Academy of Sciences, Gorkiy]

[Abstract] In order to obtain high-purity vitreous zinc chloride, studies on its purification were conducted. The starting  $ZnCl_2$  was subjected to vacuum drying, vacuum distillation, vacuum sublimation, and fractionation under reduced pressure by using film-coated and packed columns. Optical loss and levels of impurities were evaluated by IR spectroscopy. Optical transparency was inversely related to impurity levels. Zinc oxychloride was seen only in samples purified by vacuum sublimation. Vacuum distillation lowered the sulfate and nitrate levels by a factor of 15 and water and hydroxyl groups by a factor of almost 10. Vacuum sublimation decreased the oxygen content by a factor of 10 and the sulfate content by a factor of 50-100. Nitrate and ammonium ion levels decreased by a factor of up to 4, depending on the preliminary treatment. Preliminary annealing of the cuvette at about 600° under vacuum led to a decrease in hydroxyl levels by a factor of 50-100 and sulfate by a factor of 10-20. Vacuum sublimation after film-coated column fractionation gave a  $ZnCl_2$  glass with OH and ZnO bands only. Chlorination with  $CCl_4$  followed by distillation gave a glass with no absorption bands except that for sulfate and a very weak nitrate band. This

represents a decrease in OH and ZnO levels by a factor of 2,000. Small slabs of  $ZnCl_2$  glass, 30 mm long, were produced. They attenuated transmitted light no more than 2-3 percent, with OH bands below 0.3 ppm. Figures 2; references 22: 3 Russian, 19 Western.

UDC 621.793.3+539.23+621.378.004

#### Production of Indium Arsenide Layers on Semi-insulating Gallium Arsenide Base by Using Vacuum Laser Spray Method

907M0095D Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 6, Nov-Dec 89 pp 74-77 [MS Received 25 Aug 88]

[Article by V. S. Krasilnikov, V. P. Lesnikov, V. V. Podolskiy, A. F. Khokhlov, and A. L. Chernov, Gorkiy Physical Technical Research Institute, Gorkiy State University imeni N. I. Lobachevskiy]

[Abstract] A pulsed, scanning neodymium laser was used to deposit indium arsenide films on gallium arsenide in a vacuum of  $1.3 \times 10^{-4}$  Pa. The InAs target was polished with a sulfuric acid solution and heated in a vacuum to 570° for 30 minutes before irradiation. The film's crystal structure and electric properties depended on the base temperature and film thickness. At all base temperatures at or above 200°, crystallographic orientation of the film and base was noted. Film crystal structure perfection increased with temperature; at 470° it was almost monocrystalline. X-ray diffractometry showed that the angle of interblock disorientation decreased with increasing layer thickness. A study of the electrical properties of specially unalloyed layers indicated that they exhibit n-type conductivity. For a 0.27- $\mu$ m InAs layer, maximal charge carrier mobility was seen at a layer growth temperature of 470°. The charge carrier concentration exceeded that previously reported by a factor of 3-5 due to a narrower transition area in the samples produced. At film thicknesses below 0.05  $\mu$ m electron concentration decreased sharply due to complexing of the acceptor-type electron state at the film-base boundary. Figures 3; references 6: 2 Russian, 4 Western.

UDC 543.422.8

#### Measurement of Zirconium in High-Purity Hafnium Oxide by Using X-Ray Fluorescence

907M0095E Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 6, Nov-Dec 89 pp 144-145 [MS received 10 Nov 88]

[Article by Ye. K. Khomutova, S. M. Kropov, E. N. Zharikova, and Ye. K. Avetisyan]

[Abstract] Since the quantitative separation of small amounts of zirconium from hafnium is extremely difficult, an x-ray fluorescence method for measuring Zr in Hf oxides was developed. The Zr  $K_{\alpha}$  line was used for analysis. It was not possible to locate any samples of Hf that did not contain Zr, nor any standards of known Zr in the Hf content. For this reason, standards were

prepared from the Hf sample available with the lowest Zr level, estimated at 0.049 +/- 0.002 mass percent. An external standard curve was prepared for Zr concentrations of 0.011-3.3 mass percent. Analysis of the hafnium oxide samples gave results of 0.049-0.250 mass percent. References 2: 1 Russian, 1 Western.

UDC 621.314.592:546.28

### Nature of Surface Melting Centers in Semiconductors Subjected to Pulsed Heating

907M0095G Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 6, Nov- Dec 89  
pp 174-178 [MS received 25 Nov 88]

[Article by A. I. Plotnikov, V. A. Loginov, and S. I. Rembeza, Voronezh Polytechnical Institute]

[Abstract] Local liquid-phase formation after pulsed heating was studied in chemically and mechanically polished monocrystalline silicon alloyed to boron or phosphorus as well as polycrystalline silicon obtained from the gas-phase reduction of  $\text{SiCl}_4$ . A xenon lamp in air and in a  $10^{-2}$ -Pa vacuum was used for heating. Triangular or square local melt areas formed on both the irradiated and nonirradiated sides of the samples. Melt centers predominated at microdefects. The presence of impurities or epitaxial films on the surface increased the density of local melt areas. Liquid-phase formation centers in polycrystalline silica remained localized but had arbitrary shapes due to thermophysical isotropy. Irradiation in a vacuum also increased the melt center density. Analysis of the data obtained indicated that impurities are more important than structural defects in local melt area formation. When thermally oxidized silica was irradiated, liquid-phase formation was observed under the  $\text{SiO}_2$  layer. Both inhomogeneities in light energy absorption and areas of melting point depression are involved in the formation of discrete melt centers, with the second factor playing a larger role. Figures 1; References 6: 3 Russian, 3 Western.

UDC 621.315.592

### Effect of Lanthanum Solution Additives on Contamination Background in GaAs, InP, and InGaAs Formed by Liquid-Phase Epitaxia

907M0095H Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 6, Nov- Dec 89  
pp 189-192 [MS Received 4 Apr 89]

[Article by L. M. Batukova, A. V. Belyayev, B. N. Zvonkov, L. N. Znysheva, I. G. Malkina, V. N. Portnov, and T. N. Yankov, Gorkiy Research Polytechnical Institute, Gorkiy State University imeni N. I. Lobachevskiy]

[Abstract] The effect of lanthanum on the concentration and mobility of current carriers and on photoluminescence spectra at 77 K was studied in epitaxial GaAs, InP, and InGaAs layers. Lanthanum was introduced from solutions with a concentration of  $5 \times 10^{-4}$  to  $3 \times 10^{-1}$

atomic percent. The films formed with La had a mirror-like surface. Marked changes in morphology were seen only in InGaAs, which exhibited a smoother surface. Above  $3 \times 10^{-2}$  atomic percent La, layer inhomogeneity was observed. La led to a decrease in layer thickness; the thickness decreased markedly with small amounts of La and then stabilized. This was due to a decreased tendency toward supercooling. For all three materials, the concentration of electrons in the layers decreased with increasing La concentration, and this eventually resulted in transition to p-type conductivity. The La concentration at which this transition occurred depended on the residual concentration of donor impurities. The location of the photoluminescence spectral maximum was not changed by the introduction of La, whereas the peak width decreased. When InP or InGaAs were deposited on conductive bases, increased inhomogeneity and higher La concentrations for the n to p transition were observed. This may be due to the formation of a buffer layer. Annealing of In and 730° for 12 hours did not alter the charge carrier concentration, possibly due to LaH formation. The data indicate that the introduction of La lowers the donor impurity background in the In solutions and thus in the films. Figures 1; References 13: 5 Russian, 8 Western.

UDC 669.293.4:541.138.2

### Effect of Superhigh Vacuum Thermal Processing of Niobium on Electrophysical Properties of its Anodic Oxides

907M0095I Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 6, Nov-Dec 89  
pp 193-197 [MS Received 7 Apr 89]

[Article by V.M. Orlov, T.I. Ryugenen, S.D. Khanin, and A.V. Novotelnova, Institute for the Chemistry and Technology of Rare Elements and Mineral Ores, KNTs [not otherwise identified] USSR Academy of Sciences]

[Abstract] The supposition that anodic oxide films deposited on niobium that had been subjected to superhigh vacuum thermal treatment would be more homogeneous and possess better dielectric properties was verified experimentally. The niobium was annealed at 2270-2370K for 3-9 hours with a vacuum of at least  $1.3 \times 10^{-6}$  Pa. This lowered the oxygen and carbon to at least  $10^{-3}$  mass percent. The volt-amperegram of an Nb-Nb<sub>2</sub>O<sub>5</sub>-counterelectrode system demonstrated that superhigh vacuum annealing led to lower current at a constant voltage with a decrease in defects and increase in conductivity. The negative polarity voltage volt-amperegram indicated that the purified niobium gave more symmetrical characteristics. The effect of purification was similar to the effect of adding Mo or W. The decrease in cathodic current may be connected with lowered injection ability due to structural-chemical changes in the metal. This is also manifested in the alignment of electrical stability of the oxides to voltages of positive and negative polarity. The temporal pattern of the degree of crystallinity seen in the niobium films

demonstrated that superhigh vacuum annealing of the metal accelerated crystal formation, with an intensive increase in crystalline nuclei. The data indicate that superhigh vacuum annealing of niobium leads to interconnected structural-chemical changes, namely, a decrease in impurity concentration and a preference for orientation in the [110] direction, which lowers the conductivity of oxide films, makes the volt-amperegram more symmetrical, and accelerates the process of electrically stimulated crystal growth. Figures 3; References 13; Russian.

UDC 537.311.322

### Mechanism of Weak Light Absorption in High-Purity Chalcogenide Glasses

907M0095J Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 6, Nov-Dec 89 pp 198-201 [MS received 27 Mar 89]

[Article by V. I. Arkhipov and Ye. V. Yemelyanova, Moscow Physics Engineering Institute]

[Abstract] A method for evaluating the optical absorption coefficients of chalcogenide vitreous semiconductors used in fiber optics was proposed along with a method for calculating the dependence of the coefficient on light wavelength and intensity. The basic mechanism of the weak absorbency was taken to be the interaction of light quanta with carriers that are entrapped in localized states. Differential equations for the change in carrier density over time were formulated in terms of densities at a given energy, lifetimes of mobile carriers, a thermal liberation factor, temperature, and reaction cross section. Before light impinges on the trap, it is in thermal equilibrium, with its energy determined by the Fermi equation. The absorbance coefficient is 4.34 times the number of carriers divided by light intensity. Using these facts, an equation for the absorption coefficient was derived and used to generate a set of absorption coefficient versus wavelength graphs at varying light intensities. The curves merged at wavelengths between 3 and 4  $\mu\text{m}$  and approached a constant value at lower wavelengths. Absorption coefficient-versus-temperature curves had a nonactivation character. Figures 2; References 4; Russian

UDC 537.312:535.215

### Formation of Interface Boundary Between Rare Earth Metal and Semiconductor $A^{II}B^{VI}$

907M0103A Moscow POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA in Russian No 12, Dec 89 (manuscript received 25 Jul 88, after final revision 28 Sep 89) pp 96-100

[Article by A. V. Fedorov and S. I. Fedoseyenko, Scientific Research Institute of Physics, Leningrad State University]

[Abstract] Early formation stages of the boundaries between semiconductors  $A^{II}B^{VI}$  (CdS, CdSe) and rare earth metals (Dy, Ho, Gd) (REM) were studied as functions of the thickness of a metallic layer on the semiconducting support

by using the methodology of Auger electronic spectroscopy (AES). The semiconductors studied represent compounds between the purely ionic entities and those with covalent bonds. The data showed that formation of the interface boundaries (IFB) occurs in several stages depending on the thickness of the deposited REM: initial dispersion, formation of a reactive interphase, development of the final stage of the interface, and an overlayer coverup. For Dy in the thickness range of up to 0 < 7 monolayers [ML] of Cd=Se (S), bond breakage is observed along with mutual in-depth diffusion of Dy and Se and on the IFB surface. The adsorbed material and the chalcogen are intermixed and form REM=Se(S) bonds. The latter process stops further intermixing and localizes the support anions in the IFB. When the Dy thickness exceeds 7 ML, film islets of REM=Se(S) are formed, or excess Cd is segregated on the surface. Finally, a film of practically pure adsorbate is formed that contains dissolved Se(S) and Cd. The surface of the FIB formed is rich in cadmium. Figures 3; references 13: 3 Russian, 10 Western.

UDC 621.315.592

### Tunnel Emission From Improper Maue Type Surface States on Oxide-Semiconductor Interface

907M0103b Moscow POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA in Russian No 12, Dec 89 (manuscript received 21 Mar 88, after final revision 2 Aug 88) pp 101-105

[Article by V. F. Doludenko and B. S. Muravskiy, Kuban State University]

[Abstract] In this work calculations were presented of electron tunneling from Maue-type surface states localized on the oxide-semiconductor interface, whose wave functions attenuated exponentially into the depth of the crystal in both directions from the contact point. The Bardin method of matrix elements of tunnel transition and a method based on calculation of the density ratio of the transmitted and incident wave fluxes were used to calculate analytic expressions for the probability of tunnel emissions from improper states localized on the oxide-semiconductor interface. Figure 1; references 11: 3 Russian (1 by Western authors), 8 Western.

UDC 621.382

### Electrophysical Characteristics of Internal and External Interphase Oxide Boundaries in Si-SiO<sub>2</sub> Structures With Polysilicate Gate

907M0103C Moscow POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA in Russian No 12, Dec 89 (manuscript received 14 Mar 88, after final revision 5 Jul 88) pp 106-109

[Article by V. Ya. Uritskiy]

[Abstract] Layers of polycrystalline silicon  $\text{Si}_{\text{pc}}$  are widely used as gates for various MIS elements, switch bars, resistors, and insulating layers in integrated circuits. In the recent past the Si-SiO<sub>2</sub> and Si-SiO<sub>2</sub>-Si<sub>3</sub>N<sub>4</sub>

systems were among the most studied. The electrical characteristics of the interface boundary silicon-oxide, those of the oxide-polycrystalline silicon, and the values of the centroid of an overall charge in the oxide layer were determined for a capacitance field effect of 300 and a temperature of 77 K by using Si-SiO<sub>2</sub> structures with a weakly layered polycrystalline gate. It was shown that positive change in  $Q_{FB}$  was greater than in  $Q_{FB}$ . The density of surface states localized on the Si<sub>pc</sub>-SiO<sub>2</sub> interface boundary was higher than that at the Si-SiO<sub>2</sub> boundary. Distribution of mobile positive charges down the interface boundary of the oxide introduced into the postgate dielectric by a side diffusion was determined. The length of this diffusion reaches several micrometers. Figures 2; references 3: 1 Russian, 2 Western.

UDC 621.382.2

#### Local Inhomogeneities of Luminescent and Photosensitive Properties of Polycrystalline Films of Lead Chalcogenides PbS and PbTe and Relationship With Their Composition

907M0103D Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12 Dec 89 (manuscript received 9 Jun 88, after final revision 28 Sep 88) pp 118-123

[Article by V. I. Petrov, A. M. Gaskov, and A. V. Shabalin, Department of Physics, Moscow State University imeni M. V. Lomonosov]

[Abstract] Past studies showed that PbS and PbTe chalcogenides exhibited considerable spatial heterogeneity of their photosensitivity properties related to nonuniformly adsorbed oxygen. In present study Auger electron spectroscopy methods were used to study the nature of this nonuniformity. The depth composition and the surface distribution of elements were obtained for PbS and PbTe polycrystalline films. It was shown that nonuniform adsorption of oxygen is due to fine local variations in the composition of their surface related to decreased concentration of chalcogenides. A method was proposed for preparation of IR radiation photodiodes from polycrystalline PbTe films and implants of the O<sup>+</sup> ions followed by high-temperature vacuum annealing. Figures 7; references: 12 (Russian, 2 by Western authors).

UDC 548.55.535.8

#### Effect of Te Film Formed on CdTe Crystal Surface During Laser Irradiation on Their Electric and Photoelectric Properties. Simulation of Effects Related to Metastable Defects

907M0103E Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12, Dec 89 (manuscript received 14 Apr 88, after final revision 26 Oct 88) pp 129-133

[Article by A. Baydullayeva, B. R. Dzhumayev, G. Garyagdyev, N. Ye. Korsunskaya, I. V. Markevich, and

P. Ye. Mozol, Institute of Semiconductors, USSR Academy of Sciences, Kiev]

[Abstract] Some treatments of CdTe crystals, such as polishing in bromine-containing cleansers, result in the formation of thin-surface (10-100 Å) films of Te, the effects of which are normally disregarded. In the present study it has been shown that irradiation of CdTe crystals with a nanosecond-pulse ruby laser at a power density below the melting threshold leads to the formation of a fine (300 Å) Te film on their surface. The formation of this film has been shown to be related to increased  $I_T$  and  $I_F$ , the appearance of residual conductivity, a photochemical reaction imitating photostimulating formation of sticking centers in CdTe, an irregular relationship between  $I_T$  and  $I_F$ , and the laser radiation dose as well as nonstandard relaxation of conductivity after cessation of the laser pulse. These phenomena occur in p-type CdTe crystals, although in some cases (laser radiation, annealing) they are difficult to notice because of the superimposition of  $I_T$  and  $I_F$  changes occurring in CdTe itself. Figures 4; references 14: 9 Russian, 5 Western.

UDC 546.171:546.261:546.281

#### X-Ray-Electron Spectroscopy Investigation of TiAlN<sub>x</sub> Films

907M0103F Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12, Dec 89 (manuscript received 12 Apr 88, after final revision 28 Sep 88) pp 141-146

[Article by M. V. Kuznetsov, S. V. Borisov, Yu. F. Zhuravlev, R. S. Baryshev, O. F. Denisov, B. V. Mitrofanov, and V. A. Gubanov, Institute of Chemistry Ural Division of USSR Academy of Sciences, Sverdlovsk]

[Abstract] The effect of support temperature and nitrogen pressure in the working chamber on the formation of chemical bonds and the composition of TiAlN<sub>x</sub> films obtained from arc discharge plasma with an integral cold cathode was investigated by x-ray electron spectroscopy. Analysis of the spectral data showed that in the TiAlN<sub>x</sub> films obtained at T = 380°, the state of the aluminum atoms depends on nitrogen pressure: at low pressures they are in a metallic state, at high pressures they form aluminum nitride, and at the intermediate pressures they form intermediate states relating to metallic Al and aluminum nitride. At increased temperatures all the aluminum is chemically bound to nitrogen. The titanium atoms are chemically bound to nitrogen in all films obtained. The use of TiAlN<sub>x</sub> as wear-resistant coatings of instruments and construction materials could have a wide application because their deposition can be achieved at lower temperatures than those of titanium nitride. Figures 2; references 6: 4 Russian, 2 Western.

UDC 669.22:539.216.2:669.017.3

**Crystallization Characteristics of Amorphous Condensates in Ge-As-Te System**

907M0103G Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12, Dec 89 (manuscript received 10 Jul 87, after final revision 18 Aug 88) pp 147-151

[Article by I. I. Turyanitsa, Ye. I. Borkach, V. V. Khiminet, M. I. Maryan, V. A. Zuban, S. I. Kalinich, O. V. Khiminet, M. V. Polishchuk and A. P. Timashov, Uzhgorod State University]

[Abstract] The goal of this study was to apply electron microscopy to the investigation of some structural and morphologic transformations in the Ge-As-Te layers resulting from heating and illumination. These films exist in two amorphous modifications with different crystallization mechanism. Annealing or illumination ( $\lambda = 1.06\mu\text{m}$ ) results in an increase in their optical densities. The transition from the amorphous to the crystalline phase in layers rich in tellurium (Te /g 74 percent) can occur at room temperature. Rapid "aging" of such condensates makes it difficult to maintain their consistent optical recording. Layers with a lower Te content are better suited for this purpose because their phase stability at room temperature is rather constant and the transition energy into the crystalline state is low. Figures 2; references 9: 2 Russian, 7 Western.

UDC 539.211

**Electronic Structure and Reconstruction of Tantalum Surfaces**

907M0103K Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12, Dec 89 (manuscript received 3 Oct 88) pp 175-176

[Article by S. V. Mankovskiy, A. A. Ostroukhov, U. N. Tomilenko and V. T. Cherepin, Institute of Metal Physics, UkSSR Academy of Sciences, Kiev]

[Abstract] The near-surface layers of a solid body represent structures with small dimensions whose properties change with depth and may actually be different from deep layers. The electron structures of the (100) and (110) surfaces of tantalum were calculated by the method of connected linear plane waves. The presence of congruent regions associated with surface electron states on the two-dimensional Fermi surface was demonstrated, thus indicating that the Ta surface should not be subject to reconstruction. Figures 2; references 4: 1 Russian, 3 Western.

**Preparation of Ultrapure Monocrystalline Platinum Metals**

907M0143A Moscow *VYSOKOCHISTYYE VESHCHESTVA* in Russian No 1 Jan-Feb 90 (manuscript received 18 Oct 88) pp 16-19

[Article by A. M. Orlov and A. I. Kuptsova, Scientific Research Design and Construction Institute of Precious Metals and Diamonds, Moscow]

[Abstract] Analysis of the possibility of using oxidative refining coupled with fine purification methods (arc, electronic-radiation melting) identified methods for the preparation of highly purified platinum monocrystals. Analysis of the insertion impurities (oxygen carbon, nitrogen) throughout all the phases of the metallurgical cycle showed that platinum powders contain  $10^{-2}$  to  $10^{-1}$  percent oxygen and carbon. This indicates the necessity for further improvements in the refining process. Highly purified platinum, rhodium, palladium, and ruthenium may be produced by using complex refining methods including melting in an inert atmosphere and in vacuum, preliminary oxidation of the starting powders, and the addition of reducing agents. References: 8 (Russian).

UDC 546.33\*16

**Synthesis of Highly Purified Sodium Fluoride**

907M0143b Moscow *VYSOKOCHISTYYE VESHCHESTVA* in Russian No 1 Jan-Feb 90 (manuscript received 18 Sep 89) pp 20-31

[Article by S. L. Vershinin, Institute of Highly Purified Compounds Chemistry, Gorkiy]

[Abstract] The demand for highly purified sodium fluoride is great, especially in the field of fiber optics and laser technology. The most common purification methods are based on treatment of its aqueous solutions or on its synthesis from highly purified starting materials. A review was presented that covered these methods. Purification from aqueous solutions may yield the final products with  $10^{-6}$  to  $10^{-7}$  percent of trace metals but with higher levels of oxygen and some anionic impurities. In fiber optics this is not acceptable, hence inaqueous synthesis was recommended. In specific cases a combination of nonaqueous synthesis with purification from an aqueous medium may be optimal. References 71: 42 Russian (5 by Western authors), 29 Western (1 by Russian author).

UDC 543.064:546.2

**Determination of Microimpurities in Chalcogenides**

907M0143C Moscow *VYSOKOCHISTYYE VESHCHESTVA* in Russian No 1 Jan-Feb 90 (manuscript received 18 Sept 89) pp 32-43

[Article by G. G. Devyatykh and M. F. Churbanov, Institute of Finely Purified Compounds Chemistry, USSR Academy of Sciences, Gorkiy]

[Abstract] The most common impurities found in chalcogenides are various metals. The best methods for determination of their presence are based on atomic-spectral and activation analysis. Various methods for analyzing ultrapure sulfur, selenium, and tellurium were reviewed in detail, and these indicated the magnitude and diversity of the problem. Increased requirements placed on ultrapure chalcogenes necessitates the development of a highly sensitive methodology to identify these trace impurities. The review covered the following subtopics: determination of metals; identification of oxygen, carbon, and hydrogen; determination of the elements from the V and VI groups of the periodic table; identification of halides in chalcogenes and inclusion impurities of submicron dimensions in sulfur and selenium. References 86: 50 Russian, 36 Western (1 by Russian authors).

UDC 543.544:669.054

### Sorbents in Liquid-Metal Chromatography

907M0143D Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 10 Nov 88) pp 44-49

[Article by A. G. Karabash, N. G. Bogdanovich, V. S. Kopylov, V. P. Yemelyanov, A. B. Sokolov, Ye. A. Kochetkova, P. P. Us, V. I. Anosova, and V. D. Shumskaya, Physics and Energy Institute, Obninsk]

[Abstract] Liquid-metal chromatography (LMC), a method of selective separation of microcomponents from fused metals, finds application in refining, analysis, and various other studies of ultrapure metals. Principal phases of the development of LMC were reported when analyzing specific properties and the classification of high-temperature sorbents used in LMC. Frontal column chromatography is used in the separation of microcomponents during sorption filtration of liquid metals in refining metallic macrocomponents, concentrating admixtures, and selectively removing the microcomponents. A special class of high-temperature sorbent was developed for the LMC that differed substantially from sorbents for other type of chromatographies. The advantages of LMC are its effective retention of the dissolved and highly dispersed (colloidal) admixtures, low hydraulic resistance of the sorption filters, and high output, especially with increased pressures. The effectiveness of this method was demonstrated by the example of liquid sodium separation from metallic and nonmetallic radioactive impurities. references 19: 18 Russian, 1 Western.

UDC 537.32

### Thermal Electromotive Force and Electrical Resistance of Ultrapure Ytterbium at 100-1,500 K

907M0143E Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 30 Mar 89) pp 50-53

[Article by A. T. Burkov, M. V. Vedernikov, V. G. Dvunitkin, and T. V. Nikiforova, Physical-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad]

[Abstract] Metallic ytterbium exhibits complex polymorphism, and the stability of its crystallographic modifications depends on the content of trace impurities. Literature data on electrical resistance ( $\sigma$ ) and thermoelectromotive force (S) were analyzed, and new determinations of S and  $\sigma$  were made on their basis in the temperature range 100-1,500 K by using highly purified specimens obtained in a high vacuum. Experimental results showed that ytterbium distilled at high vacuum has three stable crystalline structures: hexagonal, a densely packed structure (HDP) at 0-250 K; a margin-centered cubic structure (MCC) at 260-1,020 K; and a volume-centered cubic structure (VCC) at 1020-1090 K. In the starting, nondistilled metal four structures exist: HDP (0-230 K), MCC (230- 500 K), HDP (500-950 K), and VCC (950-1,050 K). These results agreed with the values obtained by differential thermal analysis. Figures 2; references: 12 (Western, 3 by Russian authors).

UDC 669.0155:669.71

### Determination of Effective Distribution Coefficients Based on Floating Zone Refining

907M0143F Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 16 Sep 88) pp 89-92

[Article by Yu. P. Lazarenko, V. V. Serdyuk, V. N. Skobelev, S. V. Khortuntsova, E. N. Gilbert, Yu. I. Belyakov, Yu. V. Bakharev, and V. A. Shibayev, All-Union Institute of the Aluminum, Magnesium, and Electrode Industry, Leningrad]

[Abstract] A mathematical model was developed previously for floating zone refining. It described the process of the distribution of admixtures during floating zone refining in a sample of a limited length, with consideration of the effect of directed crystallization in the final zone. A rather universal Fortran program was written for this model. The program made it possible to calculate the effective distribution coefficients at all points desired. In the present work unknown effective distribution coefficients of the admixture were calculated on the basis of the known concentration profile at a given passage and the starting distribution of admixture concentrations by using this computer program. The distribution coefficients for copper, gallium, manganese, and magnesium in aluminum were determined experimentally by direct spectral analysis and the neutron activation method. The effective distribution coefficients were close to the values obtained for the equilibrium state. References: 6 (Russian).

UDC 669.04

**Impurity Redistribution During Directed Crystallization of Cylindrical Bodies***907M0143G Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 16 Jun 88) pp 93-96*

[Article by V. N. Romanenko and M. M. Dvinyaninov, Leningrad Construction Engineering Institute]

[Abstract] Redistribution of admixtures is one of the more important phenomena in directed crystallization, which is widely used in the purification of compounds, in the concentration of admixtures for analytical purposes, in growing crystals with certain preselected properties, etc. This report addresses the following situation: an infinitely long cylindrical tube is crystallizing along the radius beginning at the periphery and the internal wall under the influence of a constant removal of heat. The internal wall is adiabatic. The task was to calculate the redistribution of the admixture along the radius. This was solved analytically for a continuous cylinder in form of a series of degenerated hypergeometric Cummer functions. The task for the cylindrical tube was solved numerically. A solution with a 20 percent error may be approximated by solving the problem for a plate or a continuous cylinder. It was shown that for moderately rapid processes, purification by cylinder crystallization is more effective than by crystallization of a plate. Figures 2; references 10: 9 Russian (1 by Western authors), 1 Western.

UDC 543.064:546.183.131

**Contamination Effect of Silicate Glasses During Analytical Distillation Concentration of Impurities From Phosphorus Oxychloride***907M0143H Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 26 Jun 89) pp 97-101*

[Article by V. N. Shishov and I. Yu. Durinov, Institute of Finely Purified Compounds Chemistry, USSR Academy of Sciences, Gorki]

[Abstract] The contamination of phosphorus oxychloride by materials leached out of silicate glass during distillation concentration of other impurities was investigated in containers made of molybdenum (aluminum borosilicate) glass, quartz glass, and quartz glass with a modified surface. The experiments showed that the Fe, Mg, Mn, Cr, Al, Cu, Ca, and Na impurities observed in phosphorus oxychloride are leached out of the glass, the highest levels being observed with quartz glass and the lowest with molybdenum glass. Figures 3; references 10: 9 Russian, 1 Western (by Russian authors).

UDC 546.791.3'151:[539.27+539.193]

**Electron Diffraction Study of Molecular Structure of Uranium Triiodide***907M0143I Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 6 Sep 89) pp 109-110*

[Article by V. I. Bazhanov, S. A. Komarov, V. G. Sevastyanov, M. V. Podik, N. T. Kuznetsov, and Yu. S. Yezhov, Institute of General and Inorganic Chemistry, USSR Academy of Sciences, Moscow; Institute of High Temperatures, USSR Academy of Sciences, Moscow]

[Abstract] There are basically no experimental data on the structure of uranium iodides reported in the literature. The molecular structure of uranium triiodide was investigated by the gas electrodiffusion method and compared with data previously published for uranium tetraiodides. Synthesis of uranium triiodides was carried out in a vacuum glass vial by the direct reaction of uranium and iodine at 350°C followed by annealing at 550°C for 2 hours. Detailed physicochemical data were reported. The decreased interatomical distances observed in uranium triiodide during transition into the gas phase were related to depolarization of the molecule, which supports the covalent character of the uranium-iodine bond. References 7: 4 Russian, 3 Western.

UDC 66.063

**Effect of Pressure on Separation Capacity of Polymer Membranes During Fine Purification of Gases***907M0143J Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 26 Jun 89) pp 111-115*

[Article by V. M. Vorotyntsev, V. A. Dozorov, Yu. P. Kirillov, P. N. Drozdov, and S. A. Nosyrev, Institute of Ultrapure Compounds Chemistry, USSR Academy of Sciences, Gorkiy; Scientific Research Institute of Applied Mathematics and Cybernetics, Gorkiy State University imeni N. I. Lobachevskiy]

[Abstract] Diffusion through polymer membranes is a promising method in the technology of highly purified gases. A mathematical model was presented for the purification of gases through a polymer membrane with consideration of the pressure differential between the high-pressure and low-pressure domains. The separation ability of the membrane element was analyzed for different flow patterns: countercurrent, cross-current, and complete mixing. Experimental and calculated data were compared for the case of the countercurrent procedure and showed excellent agreement. Figures 3; references 11: 8 Russian (1 by Western authors), 3 Western.

UDC 546.56

### Preparation of Ultrapure Copper

907M0143K Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 12 Jul 88) pp 133-137

[Article by M. Yu. Riban and N. P. Stasyuk, Uzhgorod State University]

[Abstract] Ultrapure copper is used in the production of complex semiconductors. Copper sulfide ores contain a number of metallic admixtures. Copper purification methods include electrolysis, solvent extraction, vacuum purification, and zone melting (which is the most effective method). In present work the purification method involving vacuum distillation, acid etching, and directed crystallization with zone melting was applied to obtain highly purified copper 11-4. This approach completely removed all Cd, O, and S admixtures and provided significant elination of Pb, Bi, Mg, Sn, Zn, As, and other trace impurities. References 12: 9 Russian (3 by Western authors), 3 Western.

UDC 546.56'682'22'23:54-484.7

### Behavior of Microadmixtures and Macrocomponents During Growth of $\text{CuGaS}_2$ and $\text{CuGaSe}_2$ Crystals

907M0143L Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 17 Mar 89) pp 138-142

[Article by I. S. Balog, M. Yu. Rigan, and N. P. Stasyuk, Uzhgorod State University]

[Abstract] The compounds  $\text{CuGaS}_2$  and  $\text{CuGaSe}_2$  are semiconductors that are widely used in nonlinear optics and in the preparation of diodes for visible and IR-range spectra. The goal of this work was to purify the starting elements (Cu, Ga, S, Se) in order to investigate the behavior of microadmixtures and to determine the content of macrocomponents in crystalline samples of copperthio- and copperselelogallates grown from the gaseous phase. The compounds were synthesized in vacuum quartz ampules. Detailed purification of the starting elements, crystal growth, and different temperatures and analyses of the products were reported. The level of various impurities was related to the conditions of crystal growth. Elemental comparison of the grown crystals did not differ significantly from the composition of the starting batch. References 17: 10 Russian, 7 Western.

UDC 546.93:542.465

### Kinetics of Iridium Purification From Metal Impurities During Induction Oxidation Melting

907M0143M Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 26 Jun 89) pp 143-146

[Article by A. V. Yermakov, V. M. Tereshchenko, V. M. Koltygin, and V. A. Dmitriyev]

[Abstract] Crude iridium contains large quantities of oxide inclusions and gaseous and metallic impurities. To remove them, a pyrometallurgic refining process was developed based on high-temperature liquefaction in an oxidative atmosphere. It was shown that heating the material to 2,770-2,970 K with air blasting removes most of the impurities (Ni, W, Mo, and Pd down to  $10^{-4}$  percent and Re down to  $10^{-3}$  percent; iron could not be removed to levels below 0.1 percent because of the equilibrium it formed with iridium. Figures 2; references 8: 7 Russian, 1 Western.

UDC 669.293

### Auger Spectroscopy of Surface Layers of Rare Metals Obtained by Chemical Transport Reactions

907M0143N Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 16 Feb 89) pp 147-153

[Article by V. A. Shulov, I. I. Gavrilov, A. E. Strygin, G. A. Leontyev, Yu. B. Alekseyev, and M. O. Lazhechnikov, Moscow Aviation Institute imeni S. Ordzhonikidze]

[Abstract] Electronic auger spectroscopy (EAS) is one of the most effective methods for investigating the chemical composition of thin surface layers. In present paper the application of EAS to an analysis of the chemical purity of metal surface layers was described. It was shown that metal surface layers are contaminated with elements present in the surrounding medium during crystallization; elevated levels of carbon and oxygen are observed at the juncture of the metal film and the support material. In spite of its low sensitivity, EAS makes it possible to document the quality of surface layers as to their chemical purity, especially when using the Gibbs absorption equation. The physicochemical surface composition of Zr, Cr, Nb, and Ta layers was determined by using this methodology. Figures 6; references 11: 8 Russian (1 by Western authors), 3 Western.

UDC 543.253

### Inversion Volt-Amperometric Analysis of Microprobes of Refractory Metal Oxides and Film Fiber Optic Structures Based on Alkali and Alkali-Earth Metal Fluorides. Determination of Fe, Co, Ni, Bi, Cu, Pb, Zn Traces

907M0143O Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 13 Jan 89) pp 158-160

[Article by A. A. Kaplin (deceased), Z. S. Mikhaylova, and L. F. Zaichko, Tomsk Polytechnical Institute imeni S. M. Kirov]

[Abstract] The inversion volt-amperometric method described in earlier publication was applied to a determination of the microquantities of Fe, Co, Ni, Bi, Cu, Pb, Cd, and Zn in optical fibers and the metal oxides ( $\text{ZrF}_4$ , NaF,  $\text{AlF}_3$ ,  $\text{LaF}_3$ ,  $\text{BaF}_2$ ,  $\text{ZrO}_2$ ,  $\text{HfO}_2$ ,  $\text{TiO}_2$ , etc).

The metal oxides were dissolved in sulfuric acid and the optical fibers in a mixture of HCl-H<sub>3</sub>BO<sub>3</sub>-H<sub>2</sub>O<sub>2</sub>. In order to be able to determine the maximum number of trace elements from one sample, the variant of multielemental sequential inversion volt-ampere analysis was applied that was used earlier for a determination of fluorides. The apparatus, electrodes, reagents, and optimal conditions were described in previous publications. References: 10 (Russian).

UDC 543.42

#### Increased Sensitivity of Atomic Absorption Analysis

907M0143P Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 16 Jun 88) pp 165-168

[Article by A. Z. Razyapov, All-Union Electrotechnical Institute imeni V. I. Lenin, Moscow]

[Abstract] Atomic absorption methods of the elemental analysis of solid and liquid materials requires pulverization of the test specimen and ensurance of adequate concentration of the atoms in the gas phase. In the present work optimized evaporation conditions were described that lowered losses due to flow removal and diffusion processes and increased the number of atomized particles in the gas phase. Modification of the electrothermal atomizer to allow rapid local heating and elevation of the atomization temperature to 3,000°C provided the necessary conditions for increased sensitivity to expand the traditional application of atomic absorption analysis. Figures 2; references: 6 (Russian).

UDC 536.62.084-2.543.226-483

#### Novel Statistical Method of Cryometric Analysis of Ultrapure Substances

907M0143Q Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 26 Jun 89) pp 175-182

[Article by Yu. I. Aleksandrov, V. I. Belyakov, V. P. Varganov and L. Yu. Osadchaya, All-Union Scientific Research Institute of Metrology, Leningrad]

[Abstract] Precision adiabatic colorimetry is one of the most accurate methods of cryometric analysis. Nevertheless, there are several sources of systematic errors introduced by premelting and uncontrolled heat removal. These errors were analyzed for several modifications of cryometric analysis of ultrapure materials. A novel modification of this method was proposed that utilized a nontraditional supply of energy and an apparatus for adiabatic colorimetry, i.e., the Delta, for a determination of the degree of purity. The use of the function  $Q=\Phi(T)$  for a determination of the melting curve avoided the systematic errors due to uncontrolled heat removal and improved the sensitivity of this method. In addition, this unit made it possible to perform the analysis under static and dynamic conditions. Samples analyzed by both

approaches showed excellent agreement. In the past, results of the dynamic approach did not show any systemic errors; hence, it was concluded that this new method had no systemic errors in the static approach as well. Figures 3; references 7: 5 Russian, 2 Western.

UDC 666.192.539.122.04

#### Effect of Traces of Fluorine on Formation of Radiation Color Centers in Pure Quartz Glasses Prepared by Axial Deposition Method

907M0143R Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 10 Nov 88) pp 189-194

[Article by A. V. Abramov, Ye. V. Anoykin, Ye. M. Dianov, N. S. Karpychev, L. S. Korniyenko, S. M. Mazavin, V. M. Mashinskiy, M. V. Romanov, A. O. Rubaltovskiy, and A. N. Kharlamov, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] There is currently considerable interest in the studies of the effect of fluorine on the optical and radiation-optical properties of quartz glasses; this interest stems from the problems encountered in fiber optics: optical losses due to ionizing radiation. In the present work the effect of fluorine admixtures on the formation of natural and radiation color centers in pure quartz glasses prepared by the method of axial deposition from the gas phase (VAD method) was investigated by optical and EPR spectroscopy. Possible mechanisms of the generation of radiation color centers with fluorine involvement were discussed. Figures 3; references 17: 11 Russian (1 by Western author), 6 Western (2 by Russian authors).

UDC 681.7.068.4

#### Optical Absorption and Luminescence in Germanium-Silicate Glass Containing Cerium

907M0143S Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 12 Dec 88) pp 195-199

[Article by Ye. V. Anoykin, A. N. Guryanov, Ye. M. Dianov, Yu. B. Zverev, V. M. Mashinskiy, V. B. Neustruyev, and S. M. Pimenov, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] Various rare earth elements are added to pure quartz glass to improve its properties in the field of laser radiation, fiber optics, and related technologies. Optical absorption and luminescence in germanium-silicate glass containing cerium additives were investigated in an attempt to explain the interaction of cerium and germanium and their effect on the spectroscopic properties of such glass. Cerium was introduced into the germanium-silicate glass by a modified MCVD method. When using the Smakula formula, the Ce<sup>+3</sup> and Ce<sup>+4</sup> ion concentration was determined. In general, the experimental results obtained showed no interaction between germanium and

cerium at concentration levels of 1-10 percent for germanium and about 0.1 percent for cerium. Figures 3; references 15: 6 Russian, 9 Western.

UDC 666.113'161

**Identification and Investigation of Crystalline Inclusion Formation Kinetics in Glass-Forming Systems Based on Metal Fluorides**

907M0143T Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 7 Jul 89) pp 200-2023

[Article by L. N. Dmitruk, N. N. Vinogradova, M. I. Kotov, V. A. Myzina, and A. B. Chapyzhnikov, Institute of General Physics, USSR Academy of Sciences, Moscow]

[Abstract] Identification and investigation of microcrystalline phases in easily crystallizing systems is important because of the new developments in glass formation in multicomponent halide systems such as heavy metal fluorides. Such glasses crystallize easier than di typical oxide glasses, and they contain microcrystalline inclusions that reduce their strength and diffuse the light. The nature of the crystalline phases forming in the glass melting system  $ZrF_4$ - $BaF_2$ - $LaF_3$ - $AlF_3$ - $NaF$  was studied at temperatures ranging from that of the liquidus to crystallization in the hope of finding clues for ways of lowering light diffusion and increasing the strength of optical fibers. The method of growing unstable crystals by the temperature gradient in fluoride glass fusions may be used in solving the following problems: determination of crystal composition, investigation of their morphology, determination of the formation temperatures of the unstable phases, study of the initiation mechanism and growth rate, etc. Figures 2; references 6: 1 Russian, 5 Western.

UDC 669.85:86.015.4

**Synthesis of Highly Purified PrNi<sub>5</sub> and its Utilization in Nuclear Demagnetization Cryostats**

907M0143U Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 16 Mar 89) pp 204-208

[Article by G. S. Burkhanov, O. D. Chistyakov, N. B. Kolguchina, Yu. M. Bunkov, Y. Stegno, L. Skrbek, and Y. Shebek, Institute of Metallurgy imeni A. A. Baykov, USSR Academy of Sciences, Moscow]

[Abstract] The practical use of rare earth metals (REM) depends to a large extent on the ability to produce them in a pure state. Principal impurities of REM are Fe, Cu, Al, O, N, C, and other REM. The most effective method for purifying REM is based on vacuum distillation. In present work this method was used to prepare highly purified praseodmium with an electric resistance ratio of 75. Distilled Pr was subjected to detailed analysis, and 55 trace elements were found in it. PrNi<sub>5</sub> was produced by direct fusion of the components. Samples of highly

purified PrNi in the form of small cylinders (6X30-40 mm) were used as cooling agents in adiabatic nuclear demagnetization cryostats to produce ultralow temperatures. Figures 4; references 6: 2 Russian, 4 Western.

UDC 543.51.546.26

**Determination of Vanadium Concentration in Bismuth Titanate Monocrystals and Its Relationship With Optical Properties and Photoconductivity**

907M0143V Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 17 Jul 89) pp 218-228

[Article by V. M. Skorikov, V. I. Chmyrev, N. A. Chumayevskiy, M. A. Baysymakov, and V. V. Volkov, Institute of General and Inorganic Chemistry imeni N. S. Kurnakov, Moscow]

[Abstract] Bismuth-titanate monocrystals are by far the most photosensitive space-time modulators of light. Their properties may be modified by selective doping. The effect of vanadium on the photosensitive properties, IR spectra, and combined light scattering spectra of Bi<sub>12</sub>TiO<sub>20</sub> monocrystals was studied. Optically perfect monocrystals doped with vanadium oxide (0.14-0.96 percent) were prepared by the Chokhralsky method under conditions of layered growth and an axial temperature gradient of 8-10 K above the fused material. It was shown that photoconductivity of the alloyed monocrystals was higher by 1-2 orders than that of pure bismuth titanate. Some specimens showed a split photoconductivity maximum in the short wavelength range of the spectrum. The photosensitivity in slow and rapid processes increased with decreasing content of vanadium. It is possible that such compounds will show even better properties in the future. Figures 11; references 12: 9 Russian, 3 Western.

UDC 621.315:681.142.353

**Automated Equipment for Studying Electrophysical Parameters of Semicoductors**

907M0143W Moscow VYSOKOCHISTYYE VESHCHESTVA in Russian No 1 Jan-Feb 90 (manuscript received 6 Sep 89) pp 229-232

[Article by M. P. Brayman, V. M. Ilin, Yu. A. Nechuneyev, M. Yu. Pyatov, and A. V. Mokrushin, Institute of Chemistry of Ultrapure Substances, USSR Academy of Sciences, Gorkiy]

[Abstract] A study of the electrophysical properties of semiconductors makes it possible to determine their trace impurities and structural defects and such galvanometric effects in semiconductors as the Hall effect. The methodology used is involved and difficult because of the low temperatures involved. An automated unit was developed to determine such parameters in highly purified semiconductors as a function of temperature; its design is simple, and it shortens the time required for

such tests while increasing the accuracy and reproducibility of the determinations. This unit makes it possible to carry out the tests in a temperature range of 4.5-77 K; determination of 50 experimental points requires 4 hours rather than 4 days, and the reproducibility is considerably higher. Figures 2; references 5: 4 Russian, 1 Western.

UDC 621.762.2:546.48'24:547.1'13

**Production of High-Quality Cadmium Telluride Epitaxial Layers on Gallium Arsenide by Reacting Dimethyl Cadmium With Diethyl Tellurium**

907M0143X Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 20 Jul 89) pp 233-235

[Article by S. M. Batmanov, V. N. Liverko, and A. N. Moiseyev, Institute of Chemistry of Ultrapure Substances, USSR Academy of Sciences, Gorkiy]

[Abstract] Cadmium telluride monocrystals are used as support materials for the epitaxial growth of  $Cd_xHg_{1-x}Te$ . In the present work high-quality epitaxial (100) CdTe layers on (100)GaAs were obtained by the reaction of dimethyl cadmium with diethyl tellurium in a horizontal reactor with an external resistance heater at a lowered pressure. On the basis of laser mass spectroscopy, individual impurities were kept at less than  $2.4 \times 10^{-5}$  atomic percent. The morphology, crystal structure, and low-temperature photoluminescence of the resultant layers were investigated. Figures 2; references 21: 3 Russian, 18 Western.

UDC 542.65

**Behavior of Uranium and Thorium in Zone Melting of Aluminum**

907M0143Y Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 29 Jun 89) pp 235-237

[Article by A. V. Vakhobov, R. A. Altynbayev, and T. A. Yankovskaya, Institute of Chemistry imeni V. I. Nikitin, TadzhSSR Academy of Sciences, Dushanbe]

[Abstract] Ultrapure aluminum is used in the construction of gallium-germanium counters of solar neutrinos.

Such material must be essentially free of radioactive trace elements. A series of experiments was performed to investigate the behavior of uranium and thorium during the purification of aluminum by crystallization from the fused state. An analysis of 27 samples showed that the thorium and uranium concentrations were  $10^{-7}$  and  $10^{-8}$  percent, respectively. Other authors have also shown that uranium and thorium are easily removable elements. This level of purity was considered proper for detectors of solar neutrinos. Figures 2; references: 7 (Russian).

UDC 539.213:539.216.2:543.51

**Mass Spectroscopic Determination of Impurities in Thin-Film Fiber Conductors Made of Vitreous  $As_2S_3$**

907M0143Z Moscow VYSOKOCHISTYYE  
VESHCHESTVA in Russian No 1 Jan-Feb 90  
(manuscript received 30 Jan 89) pp 237-238

[Article by A. I. Buzdugan, I. I. Vataman, V. T. Dolgner, K. M. Indrichan, and A. A. Popesku, Institute of Applied Physics, MSSR Academy of Sciences, Institute of Chemistry, MSSR Academy of Sciences, Kishinev]

[Abstract] One of the principal elements of integral optics is the thin-layer fiber conductor (TFC). Analytical data on trace impurities in TFC made of  $As_2S_3$  are inadequate; therefore an attempt was made to determine the oxygen and selenium impurities in such materials. On the basis of mass spectroscopic analysis, mixed ions, As-S-O(Se), were identified in the test samples with an oxygen content of 0.15 percent and a selenium content of 0.6 percent, both in the starting material and in TFC prepared from it. Purification of these materials was difficult because these impurities intruded into the glass itself. Therefore for application in integral optics, vitreous  $As_2S_3$  should be synthesized from highly purified elemental arsenic and sulfur to avoid the O and Se impurities in the final product. References 5: 4 Russian, 1 Western.

**Cooperation of USSR and Iranian Petroleum Producers**

907M0041B SOTSIALISTICHESKAYA INDUSTRIYA  
in Russian No 206, 8 Sep 89 p 3

[TASS article from Baku: "Petroleum Producers Cooperate"]

[Text] The Caspian Sea has become an arena of cooperation between the USSR and Iranian petroleum producers. Shaft sinking of the first research well in the southern part of the sea began yesterday on the Iranian shelf of the Caspian.

According to a contract between the Iranian National Petroleum Company and the all-union association Mashinostroyexport, the Baku drillers who are based at the self-lifting drilling platform Kaspiy-2, are drilling the hole. Just this year building slips of the Astrakhan Red Brigades Plant were sunk and successfully passed industrial tests.

Powerful tugboats delivered a floating drill to the water area where Azerbaijani geophysicists had discovered a formation favorable for the occurrence of oil. The region of drilling work, which is located 27 kilometers northwest of the Iranian port of Bandar-Enzel, was preliminarily researched carefully by a Soviet-Iranian exploration expedition. Its participants drilled 18 geological engineering wells.

O. Selimkhanov, administrator of the contract and director of drilling said, "When the shaft, which goes down to a depth of 6,000 meters, is sunk, special attention will be paid to the ecological cleanliness of drilling work. Equipment for recovering depleted rock has been installed for this on the platform."

The first Soviet-Iranian well will become the beginning of joint cooperation of petroleum producers of the two neighboring countries for exploration for hydrocarbon riches.

UDC 678.744.72-488.01

**Properties of Transparent Films From Water-Soluble Polymers***907M0092A Moscow PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 27-29*

[Article by A. A. Prokopov, S. A. Golenishcheva, L. Ye. Klubnikova, and A. F. Nikolayev]

[Abstract] Optical instruments may be protected against fogging by using coatings made of transparent, water-soluble polymers having high physicommechanical and moisture-absorbing characteristics. These include, specifically, polyvinyl alcohol (PVA), polyacrylic acid (PAA), acrylamide-acrylic acid copolymer (AA+AC), chitosan in salt form, and mixtures of PVA and PAC. In the present work 90- to 110- $\mu\text{m}$ -thick films of the above copolymers were compared to determine the optimum coating material by using a previously published technique. The PVA films had optimum deformation-strength characteristics over a wide range of humidity but unsatisfactory moisture retention. The other copolymer films had better moisture retention but deformed into a swollen state readily. To prepare antifogging materials it is best to use PVA in combination with the other copolymers. Optimum clarity and strength can be obtained with a mixture of PVA containing 30 percent chitosan and 20 percent PAA or 20 percent AA+AC copolymers. Figures 2; references 6 (Russian).

UDC 678.664-13.488

**Film Materials From N-Vinylsuccinimide-Butyl Acrylate Copolymers***907M0092B Moscow PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 29-34*

[Article by L. I. Shalnova, V. M. Chudnova, and Ye. A. Trofimova]

[Abstract] Copolymers of N-vinylsuccinimide (VSI) and its analogues may be used to prepare elastoplastic films that combine good mechanical properties with high moisture retention, gas and vapor permeability, and ion-exchange capabilities. VSI forms a copolymer with butyl acrylate (BA) that is insoluble in organic solvents unless prepared in a dichloroethane or benzene medium containing benzoyl peroxide or azobutyric acid dinitrile. The BA + VSI copolymers may be used as is, in film form, or subjected to further chemical modification (alkaline hydrolysis). Properties of the films and their modifications are described. References 26 (Russian).

UDC 678.686:678.744.322:678.4-19

**Modification of Photohardened Rubber Oligomers***907M0092C Moscow PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 34-36*

[Article by M. A. Bratter, G. M. Chmireva, M. Sh. Popovich, and K. V. Belogrodskaya]

[Abstract] UV-hardened plastics are both economically and ecologically superior to thermohardened plastics in the polygraphic, electronic, and radio engineering industries. Low viscosity and high pot life of photohardened plastics facilitate film formation and cross-linking. The latter depends on the nature of the oligomer and other factors. Epoxy acrylates obtained by esterification of methacrylic acid with epoxy-containing oligomers are widely used as the photosensitive component. However, although they are highly adhesive and have satisfactory mechanical properties, they are also rigid and have high elasticity modulus values. This may be overcome by modification with low-molecular weight carboxyl-containing synthetic rubbers such as acrylonitrile or butadiene. In the present work an attempt was made to modify this photohardened composition with small additions of synthetic rubber compositions. Specifically, oligomer ED-20 was acrylated in the presence of a tertiary amine. The diacrylate epoxide oligomer was synthesized in bulk form at 130°C. The carboxyl-containing rubbers SKD-KTRA and SKN-10-1A, which differed in structure and contained 2.9 to 3.0 percent terminal carboxyl groups, served as modifiers. The results indicate that as little as 1 percent rubber significantly improves relative elongation to breaking of films at high tensile strength while also lowering the modulus of elasticity. Figure 1; references 5: 4 Russian, 1 Western.

UDC 678.686:546.26.01

**Epoxide-Novolac Graphite Plastics***907M0092D Moscow PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 36-39*

[Article by A. N. Aladyshkin, Z. G. Boyko, Yu. R. Vorobyev, and L. P. Dunayevskaya]

[Abstract] Graphite plastics, which are derived mainly from novolac phenol-formaldehyde resins, are used to fabricate high-output heat exchangers capable of prolonged operation in corrosive media at high temperatures. These plastics are also used as liners for shipping containers to protect against electrifiable dust particles. However, while providing the desired shielding effect, phenol-formaldehyde graphite plastics also have such undesirable features as low resistance to wear, low shock load, and poor adhesion to powdery materials. Epoxide novolac block copolymers (ENBC), having such features as high strength, chemical stability, and wear resistance as well as good working characteristics, are used as binders in many compositions. In the present work a study was made of the effects of block polymer composition, the technology of its preparation, and hardener content on the properties of epoxide novolac graphite plastics. Nine different grades of ENBC binders were used with synthetic graphite filler and stearic acid lubricant; the hardeners included hexamethylene tetramine, dicyanodiamide, triethanolamine, and an aminophenolic hardener. Press-powders were prepared and tested for press rate and liner panels fabricated from the press powders. Working properties of the graphite plastics

depend chiefly on the conditions of preparation and composition of the block polymer. Thus a block polymer having a low molecular weight and softening point will provide a high press rate, although the final product will have defects resulting from press powder sticking in the dosimeter and press chamber. This may be overcome by increasing the molecular weight and softening temperature of the block polymer at the cost of a slower press rate. Graphite plastics having satisfactory working features as well as high strength and shielding effect may be prepared by using a block copolymer mixture containing 870 +/- 30 and 950 +/- 50 molecular weight in a 1:2 ratio with 0.9 percent hexamethylene tetramine hardener. References 7 (Russian).

UDC 678.674.1:539.16

#### Radiation-Hardened Polyester Materials

907M0092E Moscow *PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 39-40*

[Article by A. F. Nikolayev, N. I. Duvakina, L. I. Kuznetsova, S. I. Kulicheva, G. M. Antonova, and L. P. Alymova]

[Abstract] The development of polymers that may be hardened by radiation for use as coatings on various substrates is encumbered by many difficulties. At the Chair of Chemical Technology of Plastics, Technological Institute imeni Lensovet, a study was made of the mechanism of radiation chemical hardening of unsaturated polyester resins (NPEF), and compositions were developed that are not heavily inhibited by air oxygen and may thus be sprayed on as impermeable coatings. Hardening is carried out with an Elektron-ZM accelerator. Polyester resin designated EOL is a decorative coating, while that designated KME-1 is an electrical insulator. References 10 (Russian).

UDC 678.744.422:620.178.5

#### Vibration-Absorbing Polymeric Materials

907M0092F Moscow *PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 40-42*

[Article by A. F. Nikolayev, N. I. Duvakina, and T. A. Aleksandrova]

[Abstract] Noise and vibrations may be lowered by using polymers having specific dynamic mechanical properties that respond harmonically to impressions and deformations. Mechanical damping is the result of the polymer having both liquid and solid properties so that some of the energy of vibration is absorbed and some is dissipated as heat. Vibration-absorbent materials must function over wide temperature (-60 to 150°C) and frequency (5-10,000 Hz) ranges. The efficiency of vibration-absorbing materials is measured by the tangent of the angle of mechanical loss whose maximum must lie within the temperature range where the polymer passes from the glassification to the highly elastic state. Laminar Polyakril VS (and its modifications) contain a

polymer binder (such as polyvinylacetate, polyalkylmethacrylate, rubbers, polysiloxanes, polyurethanes, PVC, etc.) between two layers of aluminum foil. Mastic materials include polyvinylacetate-modified Adem-M and Adem-T and a nonmodified dispersion (Adem). Other components include fillers, plasticizers, and fire retardants. Vibration absorbents have found applications in many branches of industry including ship and machine building and tool making. References 9 (Russian).

UDC 678.029.42.019.133

#### Fissure Resistance of Glued Joints

907M0092G Moscow *PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 42-45*

[Article by Ye. V. Moskalev, M. S. Trizno, and N. A. Ivanov]

[Abstract] The reliability of glued joint structures may be raised by increasing the fissure resistance of glued joints. This characteristic, along with tensile strength and shear strength, is used to evaluate glued joints. Tenacity, as judged by the criteria of fissure resistance, is almost independent of the geometric size of the sample, the roughness of the glued surface, and the applied load rate over a wide range. When studying shear and tensile strength according to GOST standards, it is assumed that the glue joint is without defects, and therefore only the initial stages of joint failure are noted. However, glued joints also include glue-poor sections, air bubbles, and shrunken fissures resulting from external factors. Under these conditions, the behavior of defective glue joints can only be characterized through the fissure resistance criterion. In the present work a study was made of the effects of such hardening conditions as molecular weight and temperature of the hardener on the fissure resistance of various epoxy glues based on ED-20 and SEDM-6. Various amine hardeners, maleic, phthalic, and isomethyltetraphthalic acid anhydrides, were used in conjunction with copper, lead, fluoroplast, titanium dioxide, iron, and silicon dioxide fillers. Figures 3; references 6 (Russian).

UDC 678.5.01:678.046

#### Selection of Fillers to Impart Special Properties to Polymer Materials

907M0092H Moscow *PLASTICHESKIYE MASSY in Russian No 11, Nov 89 pp 46-48*

[Article by N. I. Duvakina and N. I. Tkacheva]

[Abstract] Through the use of fillers it is possible to obtain a variety of materials having different properties from the same polymer matrix. The fillers could alter the properties of the matrix (strength, density), broaden the temperature range, and lower the level of mechanical loss, electrical conductivity, etc. Some fillers have no physicomaterial effect on the polymer but are instead used to lower its cost. In the present work a study was

made of the electrical and thermal conductivity effects of silver, copper, aluminum, and carbon fillers in powder, fiber, or scale form on polymethylmethacrylate. The

thermal conductivity studies also included nickel, titanium dioxide, boron and silicon nitrides, and graphite. References 17: 5 Russian, 12 Western.

UDC 538.566.5

**Experiments on X-ray Reflection From Surfaces With Different Degree of Roughness**

907M0103H Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12, Dec 89 (manuscript received 12 Sep 88, after final revision 28 Sep 88) pp 164-165

[Article by M. V. Gubarev, V. Ye. Kovantsev, A. I. Kolomiitsev, M. A. Kumakhov, I. Yu. Ponomarev, and I. A. Khodeyev, Institute of Atomic Energy imeni I. V. Kurchatov, Moscow]

[Abstract] Surface roughness plays an important role in the reflection of x-ray radiation from a solid body. On a rough surface a total diffusion scatter of the x-rays takes place, while practically the entire radiation is reflected from a smooth surface. The ability to reflect x-ray irradiation from a number of different materials (copper, aluminum,  $MgF_2$ , optical class K8, ceramic glass, K8 glass with a copper layer deposited on it) was determined by evaluating their use in the preparation of various components of x-ray optics. Experimental results were reported in tabular form and graphically. Figure 1; references 3: 2 Russian, 1 Western.

UDC 621.382:621.375.826:535

**Gigantic Amplification of Photoreflexion From Cadmium-Plated Near-Surface Region of Cadmium Sulfide Single Crystal**

907M0103I Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12, Dec 89 (manuscript received 13 Jul 88, after final revision 28 Sep 88) pp 166-168

[Article by P. F. Oleksenko, Ye. V. Oreshko, S. A. Pendyur, S. V. Svechnikov, and O. N. Talenskiy, Institute of Semiconductors, UkSSR Academy of Sciences, Kiev]

[Abstract] The presence of submicroscopic metallic particles on the surface or in the near-surface volume leads

to a gigantic Raman scatter effect, intensified generation of second harmonics, and anomalous light absorption. It was shown previously that He-Cd laser irradiation of CdS monocrystals in water leads to an enrichment of the near-surface region with cadmium. In present work it was shown that the excess of this cadmium formed is about 10-15 percent; because of poor solubility of Cd in CdS, an assumption could be made that this excess is in form of clusters or metallic inclusions. It was shown that in the transparency region the photoreflexion from the near-surface cadmium-plated region exceeded such an effect from a clean CdS surface by a factor of  $10^3$ -fold. A time delay up to 1.5 seconds was noted between the illumination impulse and its photoreflexion. Figures 3; references 6: 4 Russian, 2 Western.

UDC 546.48'47'22:539.216.2.535.37

**Luminescent Properties of Thin ZnS:CdS Films Obtained by Dispersion of Solutions on Heated Support**

907M0103J Moscow *POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA* in Russian No 12, Dec 89 (manuscript received 8 Feb 88, after final revision 26 Dec 88) pp 168-170

[Article by V. N. Semenov, V. G. Klyuyev, M. A. Kushnir, and A. V. Markov, Voronezh State University]

[Abstract] Solid solutions in the system CdS-ZnS are widely used in the production of luminescent screens.  $Cd_xZn_{1-x}S$  layers exhibit excellent adhesion and insignificant scatter of the light. In this work luminescent properties of such films were studied; the material was prepared by spraying a cadmium and zinc salt solution simultaneously with thiourea onto a heated support. Solid solutions are obtained by this method at relatively low temperatures. The most interesting properties were exhibited by films prepared in the temperature range of 550-650 K. With an increase in ZnS in these layers, the luminescence maximum shifted toward the short wavelength, and its intensity increased.  $Cd_{0.5}Zn_{0.5}S$  layers exhibited the greatest brightness. The brightness diminished with the transition to ZnS. Figure 1; references: 5 (Russian).

UDC 547.458.81

**Study of Cellulose of Bark and Wood Fiber of Major Wood Species of Karelia by IR Spectroscopy. I. Development of Specimen Preparation Methods**

907M0017C Riga KHIMIYA DREVESINY in Russian No 4, Jul-Aug 89 (Manuscript received 16 Apr 88; after revision 01 Nov 88) pp 34-38

[Article by I. S. Geles, N. A. Ponkina, and V. B. Litevina, Institute of Wood, Karelian Affiliate, USSR Academy of Sciences]

[Abstract] In order to obtain specimens for IR spectroscopy that retain the supermolecular structure and intermolecular bonding inherent in cellulose swollen in water in various stages of the production process and to ensure a more uniform distribution of the alkali metal halide (particularly in the interfibrillar spaces), the authors have developed a method of preparing specimens from moist cellulose. The essence of the method is that preparations for IR spectroscopy are prepared from poured cellulose with a moisture content of 60-85 percent. Plates cut from such "castings" 20 mm in diameter are impregnated with a saturated aqueous solution of an alkali metal halide for 1-6 hours at 20 °C and then transferred to anhydrous ethyl alcohol saturated with potassium bromide. The alcohol is then extracted by replacing the solvent with anhydrous diethyl ether saturated with the same halide. This method basically retains the structure of the moist cellulose. Figures 5; References 11: 10 Russian, 1 Western.

UDC 547.458.81

**Change in Cation Exchange Properties of Molybdenum-Containing Hydrate Cellulose During Carbonization**

907M0017D Riga KHIMIYA DREVESINY in Russian No 4, Jul-Aug 89 (Manuscript received 23 Feb 88) pp 39-42

[Article by N. V. Gulko, G. V. Snopko, and I. N. Yermolenko, Institute of General and Inorganic Chemistry, Belorussian Academy of Sciences]

[Abstract] A study is made of the formation of ion-exchange properties during carbonization of hydrate cellulose containing ammonium paramolybdate. Carbonization of the hydrate cellulose with ammonium paramolybdate at 510-670 K forms monofunctional cationites with an exchange capacity of 3.5-6.5 mgEq/g, the acidity of which decreases with increasing heat treatment temperature. Stable ionites are obtained if the molybdenum is introduced into the cellulose before carbonization by sorption from alkaline solutions. Figures 4; References: 6 Russian

UDC 634.0.861.16:542.943

**Oxidation of Wood Fiber by Oxygen in Low-Molecular Mass Alcohols**

907M0017E Riga KHIMIYA DREVESINY in Russian No 4, Jul-Aug 89 (Manuscript received 02 Mar 88) pp 60-63

[Article by I. P. Deyneko and O. V. Nikitina, Leningrad Wood Engineering Academy imeni S. M. Kirov]

[Abstract] Preliminary results are presented from the oxidation of wood fiber by oxygen in low-molecular mass alcohols (methanol and propanol) without a base present. Oxidation of shavings was performed in a 1-liter rocking autoclave made of stainless steel. The results indicate the possibility of producing cellulose by delignification of wood fiber with oxygen in water-alcohol mixtures. Figures 3; References: 5 Russian.

UDC 634.0.813.6:094.403

**Chlorination of Lignocellulose Materials**

907M0017F Riga KHIMIYA DREVESINY in Russian No 4, Jul-Aug 89 (Manuscript received 30 Mar 88; after revision, 11 Nov 88) pp 64-67

[Article by L. A. Serorus, Z. A. Maslinkovskaya, I. P. Kim, S. V. Demidov, and A. I. Mikhaylov, Institute of Chemical Physics, USSR Academy of Sciences; Institute of Organic Chemistry, Kirgiz Academy of Sciences]

[Abstract] This article studies a free-radical process of the radiation-chain chlorination of cellulose and wood fiber in which initiation is by macroradicals formed under the influence of  $\gamma$ -radiation. EPR spectra were recorded at 77 K with a microwave radiating power of 0.3 mW. EPR spectroscopy, scanning calorimetry, and elemental analysis show that chlorination of cellulose materials causes attachment of chlorine to the glucopyranose link of the cellulose macromolecule. The degree of chlorination achieved by this method can achieve 20 percent. Figures 4; References: 11 Russian.

UDC 676.16.02.2.43

**Study of Properties of Fiber Intermediates and Paper by Twisting Oscillations**

907M0017G Riga KHIMIYA DREVESINY in Russian No 4, Jul-Aug 89 (Manuscript received 16 Apr 88; after revision, 22 Aug 88) pp 86-90

[Article by S. N. Nikolskiy, T. V. Gracheva, T. A. Ivanova, and T. V. Shalimova, All-Union Paper Industry Scientific Production Association]

[Abstract] An attempt is made to uncover the relationship of shear modulus and quantity of material per unit volume in paper and wood pulp products. Fiber intermediates are used that are obtained under laboratory and pilot-scale industrial conditions. The main factor in determining the dynamic shear modulus is found to be the ratio of mass per unit volume. Figures 5; References: 7 Russian.

UDC 541.66+541.69.11

UDC 537.63

**Model Estimates of Anesthetics' Interaction With Biomembranes**

907M0073E Moscow *ZHURNAL FIZICHESKOY KHMII in Russian Vol 63 No 10, Oct 89 (manuscript received 13 Dec 88) pp 2817-2820*

[Article by G. A. Isayeva and P. P. Isayev, Bryansk State Pedagogical Institute imeni I. G. Petrovsky]

[Abstract] The search for a heuristic model to quantitatively evaluate the interrelationship between the physiological activity of an anesthesia with its physical chemical properties is a quantitative problem both at the macro and molecular levels, and this makes it possible to form a model at the classic, well-founded structural activity level. In the present work a physical model for the interaction between a molecule of a local anesthetic with a biomembrane surface was used to find a mathematical correlation between the biological activity of the preparation and the intermolecular energy of the reaction. It was demonstrated that the minimum blocking concentration needed for total blocking of neural excitation is a function of the dispersed energy of interaction between the anesthesia molecule and the biological membrane. The enthalpy of vaporization of molecular liquids is correlated with the anesthetizing activity of alcohols and certain other compounds. Vaporization enthalpies of various alcohols and other compounds were calculated. Figure 1; references 12: 6 Russian, 6 Western.

**One Possible Mechanism for Action of Weak Magnetic Fields on Biological Systems**

907M0073F Moscow *ZHURNAL FIZICHESKOY KHMII in Russian Vol 63 No 10, Oct 89 (manuscript received 23 Jan 89) pp 2835-2838*

[Article by V. F. Kiselev, A. M. Saletskiy, and L. I. Semukhina, Moscow State University imeni M. V. Lomonosov; Tyumen State University]

[Abstract] Although much material has been published on the effects of weak magnetic fields on the vital activity of various organisms, there is little basis for the mechanism of this effect. A hypothesis has been advanced that this mechanism has a universal effect on the water contained in any biosystem, but how the magnetic field acts on the diamagnetic water molecules remains unclear. In the present work a study on the effect of weak magnetic fields on the water molecules contained in human serum albumin shows that very weak interactions of a magnetic field with the charged products of thermal dissociation of water and their spins results in macroscopic changes in the entire structure of the water and the albumin dissolved in it. Such processes are typical for biosystems, and the observed changes in the dissociation constants of water and the related changes in the hydrogen bond network (entropy) could have an effect on the life activity of a living organism. Under real conditions, these purely protonic processes are superimposed with the effects of dynamic polarization of nuclei and radicals ever present in cell fluids. These effects might also be the basis for various manifestations of variations in the electromagnetic field of the universe on all living matter. Figures 2; references 11: 8 Russian, 3 Western.

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