

6(4); 7(7)

PHASE I BOOK EXPLOITATION

SG7/2673

Zhabotinskiy, Mark Yefremovich and Irina L'vovna Radunskaya

Radio nashikh dney (Modern Radio) Moscow, Izd-vo AN SSSR, 1959. 262 p.
(Series: Akademiya nauk SSSR. Nauchno-populyarnaya seriya) 50,000
copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Redkollegiya nauchno-populyarnaya
seriya.

Ed.: I.S. Dzhigit; Ed. of Publishing House: L.V. Gessen; Tech. Ed.:
T.P. Pölenova.

PURPOSE: This book belongs to the series of scientific-popular publications of
the Academy of Sciences, USSR, and is intended for the general reader.

COVERAGE: The authors present a brief history of the development of radio, men-
tioning a number of Russian, Soviet and non-Soviet Scientists who contri-
buted to the development of modern radio. They emphasize the cultural and
educational importance of radio broadcasting and list some of the various

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2

SOV/2673

Modern Radio

applications of radio in industry and research. They also mention plans for future development of radio broadcasting and communications in the USSR according to the Seven-Year-Plan. For the nonspecialist, the authors offer a short introduction to the physical phenomena on which radio is based. There are no references.

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2

SOV/109-59-4-2-14/27

AUTHORS: Bazarov, Ye.N. and Zhabotinskiy, M.S.
 TITLE: Frequency Changing by Means of a Reflex Klystron
 (Preobrazovaniye chastoty na otrazhatel'nom klistrone)
 PERIODICAL: Radiotekhnika i Elektronika, 1959, Vol 4, Nr 2,
 pp 253-261 (USSR)

ABSTRACT: The possibility of employing a reflex klystron as a frequency changer at U.H.F. is investigated theoretically. For the purpose of analysis it is assumed that a klystron can be represented by the equivalent circuit shown in Fig 1, where R, L and C are the equivalent parameters of a loaded resonator and i_k is the alternating component of the convection current. If the multiple transit of the electrons, the interaction of the electrons in the beam, the capture of the electrons at the grids and the transit time of the electrons in the grid gap are neglected, the equations for the klystron can be written as:

$$L \frac{di}{dt_1} + Ri = U + U_B \quad (1)$$

$$\frac{dU}{dt_1} = -\frac{i}{C} + \frac{ik}{C}$$

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Frequency Changing by Means of a Reflex Klystron

where U is the voltage at the grids of the resonator, $U_B = E \sin(\omega t_1)$ is the external signal voltage, $n = 0, 1, 1/2, 1/3, \dots$ is the total current in the resonator and i_k is the alternating component of the convection current. Equations similar to Eq (1) were considered in a work of Bershteyn (Ref 3). If the notation shown on page 254 is adopted, Eq (1) can be written as Eq (2). Further, by eliminating y from Eq (2), the final equation is in the form of Eq (6). The solution of this equation is in the form of a superposition of the oscillations with multiple frequencies and is given by Eq (7). The amplitudes A, A_1, \dots and phases ϕ, ϕ_1 are slowly variable functions of time and can be obtained by solving Eq (8). The functions Φ and Ψ in Eq (8) are defined by Eq (9). In the case of a resonance of the second kind and the synchronization at the second harmonic ($n = 2$), functions Φ and Ψ can be expressed by Eq (10). The conditions of stability of the steady-state regime are defined by Eq (11). These can also be written as Eq (13), where m is the regeneration

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coefficient of the klystron and $v_1 = \xi/2\theta$. If the parameter ϕ_0 is eliminated from Eq (8), an expression in the form of Eq (12) is obtained. On the basis of Eq (12), it is found that the threshold of the resonance of the second kind is given by Eq (15). From this it follows that: the threshold increases with the increase of the detuning parameter v_1 ; the increase of the regeneration leads to the reduction in the threshold of the resonance and the deviation of the transit angle from its optimum value causes the increase in the resonance threshold. The width of the resonance of the second kind is expressed by Eq (16) where Q is the quality factor of the resonator. The synchronization threshold at the second harmonic can also be found from Eq (12) and is defined by Eq (17). The synchronization bandwidth for the optimum transit angle is expressed by Eq (18). The dependence of the amplitude of the oscillations during synchronization at the second harmonic (at the voltage of the external signal) is illustrated in Fig 3. The synchronization effect was also investigated experimentally by employing a special reflex klystron

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SOV/109-59-4-2-14/27

Frequency Changing by Means of a Reflex Klystron

fitted with two resonators and three or four grids (see Fig 4). The experiments carried out on a 3-grid reflex klystron corroborated the possibility of employing the tube as a frequency divider at U.H.F. It was possible to obtain an output power of 15 mW for input powers of 10-20 mW. The klystron can be used as a multiplier in two ways; the external signal of frequency f is applied to the tube which is tuned to a frequency nf ; in the second case, the resonator frequency is the same as that of the external signal and the multiplication is obtained by extracting the n -th harmonic of the bunched current. When the klystron is synchronised at a sub-harmonic and used as a frequency multiplier, Eq (8) and (9) are also valid and in this case the functions Φ and ψ (for $n = 0.5$) are given by Eq (19). The amplitude of the steady state oscillations can be determined from Eq (20). If the n -th harmonic of the bunched current is employed, the functions Φ and ψ are given by Eq (21), while the amplitude of the steady state voltage at the resonator gap is expressed by Eq (22).

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The conditions of stability of the oscillator are expressed by Eq (11). The above two methods of frequency multiplication were confirmed experimentally. There are 5 figures and 5 Soviet references.

SUBMITTED: 17th June 1957

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311

9,3260

S/109/60/005/07/017/024
E140/E163AUTHORS: Zhabotinskiy, M.Ye., Levkin, L.V., Sverchkov, Ye.I.,
and Petisova, V.R.TITLE: Model of a Caesium Frequency StandardPERIODICAL: Radiotekhnika i elektronika, Vol 5, No 7, 1960,
pp 1173-1176 (USSR)

ABSTRACT: In accordance with a recommendation of the Twelfth General Assembly of the International Radio Scientific Union the comparison of a molecular generator¹² with a caesium standard within a single laboratory has been undertaken. Two models of an atomic frequency standard using an atomic caesium beam have been developed at the Institute of Radio Engineering and Electronics of the Academy of Sciences, USSR. In this system the ultra-fine structure in the atomic caesium spectrum is used, employing two closely located levels between which transitions occur at a frequency of about 9192 Mcs. In a weak magnetic field these levels are subjected to Zeeman splitting. The system consists of a copper tube 12 mm in diameter, 1200 mm long, in which a high vacuum is maintained. The magnetic field of the system is uniform to within 0.1 oe. The spectral line width is 300 cps, the signal/noise ratio about 100. There are 4 figures and 15 references of which 12 are English and 3 Soviet.

SUBMITTED: January 3, 1960. ✓

Card 1/1

9.2500, 9.4220

77565
SOV/108-15-2-10/12

AUTHORS: Bazarov, Ye. N., Zhabotinskiy, M. Ye., Sverchkov, Ye. I.

TITLE: Frequency Multiplication by a Large Factor Using a Reflex Klystron

PERIODICAL: Radiotekhnika, 1960, Vol 15, Nr 2, pp 75-79 (USSR)

ABSTRACT: The paper deals with frequency multiplication by a large factor n using a standard reflex klystron. In principle, the input signal is applied at the airgap between the reflector and the resonator. However, in the practical application the input signal may be supplied to the klystron reflector by means of a coaxial line. The differential equation of the second order describing the processes in a reflex klystron is given. Using the first approximation of the above equation, and assuming that the amplitude of the input signal as well as that of the output signal is smaller than the constant

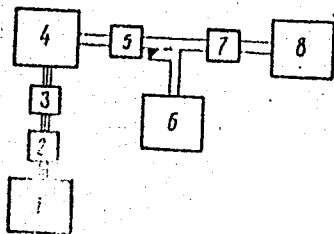
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Frequency Multiplication by a Large Factor
Using a Reflex Klystron

77565

SOV/108-15-2-10/12

voltages on the klystron electrodes, expressions are derived which define: (1) the power of the output signal of frequency $f_{out} = n f_{in}$, where f_{in} is frequency of the input signal; (2) the band width Δf in which a stable multiplication is obtained. Δf depends on the cathode current, the reflector voltage, and on the factor n . The block diagram of an experimental installation for frequency multiplication is shown on Fig. 1.



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Fig. 1.

Frequency Multiplication by a Large Factor
Using a Reflex Klystron

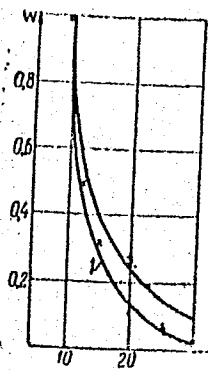
77565
SOV/108-15-2-10/12

Here the input signal from the generator (1) is supplied through the measuring line (2), the attenuator (3), and through a coaxial line to the reflector of klystron (4). The klystron output signal passes through the attenuators (5) and (7) to the spectrum analyzer (6) and power measurer (8), respectively. The klystron operates as a regenerator. The klystron resonator is tuned to the n -th harmonic of the input signal. In the above installation, a standard 3-cm-wave klystron was used and frequencies $f_{out} = n f_{in} = 9,000$ to $10,000$ Mc were obtained. The relationship between the output power and the multiplication factor n is shown on Fig. 2, where the power for $n = 10$ is assumed to be equal one.

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Frequency Multiplication by a Larger Factor
Using a Reflex Klystron

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Fig. 2

Frequency Multiplication by a Larger Factor
Using a Reflex Klystron

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Here the curve (1) is obtained experimentally; the curve (2) is plotted according to the theory. For the considered 3 cm wave, Δf was 3 to 20 mc, the experimental and theoretical results showing a good coincidence. At $n = 30$, an output power of the order of 500 to 1,000 microwatts may be obtained. The author arrives at the conclusion that the suggested multiplication method is extremely simple and reliable. The power of the output oscillation is relatively high. There are 4 figures; and 4 Soviet references.

SUBMITTED: July 16, 1958

Card 5/5

9,2585
9,4220

21441

S/109/61/006/001/020/023

E140/E163

AUTHORS: Bazarov, Ye.N., and Zhabotinskiy, M.Ye.
TITLE: Fluctuations in a reflex-klystron oscillator caused by electron velocity scatter, shot and thermal effects
PERIODICAL: Radiotekhnika i elektronika, Vol.6, No.1, 1961, pp. 166-169
TEXT: Using symbolic equations and correlation theory the fluctuations in a reflex-klystron oscillator caused by the scatter of electron velocities in the beam, the shot and thermal effects are analyzed. Expressions are obtained for the mean-square amplitude and phase fluctuations and their spectra. It is shown that under certain conditions the electron velocity scatter can have a substantial influence on the fluctuation. There are 4 Soviet references.
SUBMITTED: June 15, 1960

Card 1/1

2143

S/109/61/006/001/022/023
E140/E163

9,2582 (incl. 2185)

AUTHORS: Grigor'yants, V.V., and Zhabotinskiy, M.Ye.

TITLE: Ammonia molecular generator operating without liquid nitrogen

PERIODICAL: Radiotekhnika i elektronika, Vol.6, No.1, 1961, pp. 175-177

TEXT: This note discusses the pumping requirements of an ammonia molecular oscillator operating without a liquid nitrogen trap, developed by the present authors and G.A. Vasneva (Refs. 1, 2). Signal to noise ratios in the order of 10 - 20 are found for various forms of trapless oscillators, as against 25 - 40 when liquid nitrogen traps are used.

Acknowledgements are expressed to I.N. Orayevskiy and G.P. Barykin for their participation in the experiments; G.A. Semenov is mentioned.

There are 2 figures, 1 table and 2 Soviet references.

SUBMITTED: July 12, 1960

Card 1/1

20584

S/109/61/006/002/016/023
E140/E435

9,2585

AUTHORS: Grigor'yants, V.V. and Zhabotinskiy, M.Ye.

TITLE: Molecular Frequency Standard With Subtraction of Reference Oscillator Error

PERIODICAL: Radiotekhnika i elektronika, 1961, Vol.6, No.1, pp.321-328

TEXT: The article concerns a system for using the molecular frequency standard to stabilize reference oscillator frequency and phase without the use of a feedback loop. The simplified schematic of the system is given in Fig.1, where 1 is the molecular oscillator, 2 is a frequency multiplier xn , 3 is the crystal reference oscillator, 4 is a frequency divider n . The article concerns a practical realization of the system using two klystrons and a quartz-crystal reference oscillator, giving output at centimeter, decimeter and meter wavelength. Circuits are described which are claimed to measure the phase fluctuations of the resulting signal without the need of an external standard. No numerical data are given in the article insofar as concerns the operating frequencies, multiplication

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20584

S/109/61/006/002/016/023

E140/E435

Molecular Frequency ...

factors etc. There are 7 figures and 10 references: 8 Soviet and 2 non-Soviet.

ASSOCIATION: Institut radiotekhniki i elektroniki AN SSSR
(Institute of Radioengineering and Electronics AS USSR)

SUBMITTED: March 1, 1960

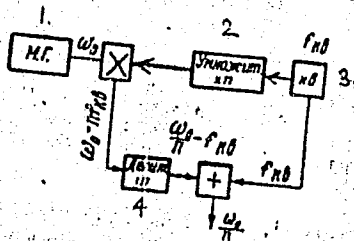


Fig. 1.

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ZHABOTINSKIY, M.Ye; RADUNSKAYA, I.L.

The time by which we live. Priroda 50 no.4:9-16 Ap '61.
(MIRA 14:4)

(Time)

ZHABOTINSKIY, Mark Yefremovich, doktor tekhn. nauk; RADUNSKAYA,
Irina L'vovna; FAYNBOYM, I.B., red.; RAKITIN, I.T., tekhn.
red.

[Time by which we live] Vremia, po kotoromu my zhivem. Moskva,
Izd-vo "Znanie," 1962. 46 p. (Novoe v znani, nauke, tekhnike.
IX Seria; Fizika i khimia, no.14) (MIRA 15:7)
(Time measurements)

ZHABOTINSKIY, M. Ye. [Zhabotyns'kyi, M. IE.]; RADUNS'KA, I. L.

The time in which we live. Dos. such. fiz. no.6:145-154 '62.
(MIRA 16:1)

(Time)

38210

S/109/62/007/005/013/021
D201/D308

24,7900

AUTHORS: Atsarkin, V.A. Zhabotinskiy, M.Ye., and Frantsesson, A.V.

TITLE: Achieving the limit sensitivity of a radio-spectroscope for the observation of electron paramagnetic resonance

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 5, 1962, 866 - 873

TEXT: The authors consider the three basic noise sources which limit the sensitivity of a paramagnetic radio-spectroscope; the SHF receiver noise, the relative frequency instability of the signal generator and of the cavity resonator and amplitude and frequency instability noise of the local oscillator (where applicable). After comparing various radio-spectroscope systems it is concluded that maximum sensitivity is obtained in a superheterodyne system with double magnetic field modulation and AFC from the cavity resonator, in which system the effect of both klystron and resonator instability on sensitivity may be neglected. Relevant circuits of an actual
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Achieving the limit sensitivity ...

S/109/62/007/005/013/021
D201/D308

superheterodyne radio-spectroscope are given, the instrument operates at 29,5 mc/s and has a deep 50 c/s modulation of the magnetic field. Its calculated sensitivity, with the receiver noise only, should be 6×10^{-13} g/mol DPG [Abstractor's note: Diphenyl guanidine?] with the Q of the resonator equal to 10^4 and the indicating instrument passband of 2 c/s. The experimentally measured sensitivity was actually found to be 2×10^{-12} g-mol DPG, which is considered to be in good agreement, if the inaccuracy of such factors as the r.m.s. value of noise is taken into account. The experimentally found sensitivity of the instrument when observing the paramagnetic resonance signal on a CRO was found to be 2×10^{-10} g-mol DPG with the receiver pass-band of 12.5 kc/s. There are 4 figures.

SUBMITTED: June 17, 1961

Card 2/2

33790
S/108/62/017/002/005/010
D201/D305

9,3280 (1147,1159)

AUTHORS: Zhabotinskiy, M.Ye., and Sverdlov, Yu.L., Members of the Society (see Association)

TITLE: Design of a multi-stage frequency multiplier

PERIODICAL: Radiotekhnika, v. 17, no. 2, 1962, 31 - 41

TEXT: The authors consider a novel frequency multiplier circuit, based on the results of the previously published work of Sverdlov (Ref. 1: Radiotekhnika i elektronika, v. 4, no. 7, 1958); (Ref. 2: Ibid., v. 4, no. 6, 1959). The basic frequency multiplying network consists of two stages: A multiplier stage having in its anode a circuit with one and a half degree of freedom (Ref. 1: Op.cit.) and a buffer class C stage with a single tuned circuit in the anode. When oscillations having frequency f are applied to this network, these oscillations are in practice transformed into oscillations having a frequency nf . The high degree of filtering is achieved not due to the use of narrow band filters, but owing to the utilization of certain specific non linear effects, best illustrated when con-

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S/108/62/017/002/005/010
D201/D305

Design of a multi-stage frequency ...

sidering Fig. 1. The anode current pulses $i_1(t)$ in the multiplier stage excite the circuit with $1 \frac{1}{2}$ degrees of freedom, tuned to frequency ω . The specific transient response of this circuit makes it possible to obtain at the buffer stage a sequence of current pulses, modulated in a well-determined manner in width and in amplitude. It was shown (Ref. 2: Op.cit.) that when a sequence of pulses with this type of modulation excites a single tuned circuit, the amplitude-phase modulating resulting from the induced transient is contained only in the negative half waves. Since the positive halves of this response contain practically no modulation, the current pulses applied to the next stage after being limited from the bottom do not contain any modulation either. The physical explanation of the above-effect is that when a resonant circuit with $1 \frac{1}{2}$ degrees of freedom is pulse excited, owing to dying oscillations an exponential transient response occurs which adds to the attenuated oscillations and equalize the maxima of positive halves of the wave. Three practical circuits having $1 \frac{1}{2}$ degrees of freedom, called by the authors "correction" circuits are given in Fig. 4., their ope-

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Design of a multi-stage frequency ...

rations discussed and design parameters given. Such circuits have been proposed by Yu.L. Sverdlov (Author's certificate No. 124007 of September 3, 1957) but so far have not found many applications. The formulas derived were used for design and construction of a three stage $N_1 = 5 \times 5 \times 4 = 100$ and of a six stage $N_2 = 5 \times 5 \times 4 \times 3 \times 2 \times 88 = 52800$ multiplier. In the last amplifier $n_6 = 88$ stage was designed around a germanium detector using standard multiplication techniques. The experiment showed good agreement with the theory. The side band components in the output wave spectrum were 1×10^{-5} of the fundamental amplitude (calculated value 0.77×10^{-5}) for the three-stage multiplier and were 50 db down (theoretical value -48 db) in the 6-stage multiplier. When the 3 stage multiplier was designed around the normal resonant circuit stages, the side band spectrum components were 10^{-1} of the fundamental. The noise meter ИП-12-М (IP-12-M) which in fact is nothing else, but a calibrated wave analyzer was used for tuning the separate ccts and the multiplier as a whole. Since all stages are tuned to different frequency, the stability is determined by the stability of each stage separately. The most critical is, of course, the last stage, tuned
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S/108/62/017/002/005/010

D201/D305

Design of a multi-stage frequency ...

to the highest frequency; it is stable up to 100 - 150 mC/s with tubes having $C_{ag} \cong 2 \times 10^{-2}$ nF and $g_m \cong 5$ mA/V. In the appendix the authors give a table of practical design formulas for the k-th stage of a multi-stage frequency multiplier using the same type of tubes throughout. There are 2 tables, 7 figures and 6 Soviet-bloc references.

ASSOCIATION: Nauchno-tekhnicheskoye obshchestvo radiotekhniki i elektrosvyazi im. A.S. Popova (Scientific and Technical Society of Radio Engineering and Electrical Communications imeni A.S. Popova) [Abstractor's note: Name of Association taken from first page of journal]

SUBMITTED: October 28, 1960 (initially)
October 25, 1961 (after revision)

Card 4/5/1

ATSARKON, V.A., ZHABOTINSKIY, M.YE., FRANTSESON, A.V.

"Electron spin resonance of trivalent chromium ions in spinel and magnesium tungstate crystals."

Report submitted to the Third Intl. Conf. on Quantum Electronics,
Paris, France 11-15 Feb 1963

GRIGOR'YANTS, V.V.; ZHABOTINSKIY, M.Ye.

Orifice for obtaining fine-calibrated gas flows. Izv. tekhn.
no.12:44-45 D '63. (MIRA 16:12)

ACCESSION NR: AP4009982

S/0109/64/009/001/0114/0117

AUTHOR: Zhabotinskiy, M. Ye.; Frantsesson, A. V.

TITLE: Paramagnetic amplifier for planet radar

SOURCE: Radiotekhnika i elektronika, v. 9, no. 1, 1964, 114-117

TOPIC TAGS: paramagnetic amplifier, radar, planet radar, 700 mc paramagnetic amplifier, Venus radar investigation, Mercury radar investigation, radiotelegraphy via Venus

ABSTRACT: A 700-mc paramagnetic resonator-type amplifier was developed and built for radar probing of the planets. A ruby with a 0.017% Cr concentration is used as a paramagnetic substance; the magnetic figure of merit is found to be proportional to the temperature within 1.7-4.2K. A constant magnetic field of about 140 oerst is oriented at right angles to the crystal axis. The two-frequency resonator is represented by a quarter-wave strip line. Cooled to liquid helium temperature, the resonator is tuned to about 11.0 kmc. An AFC system tunes the pumping klystron to the resonator with a stabilization coefficient of over

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ACCESSION NR: AP4009982

10,000. At pumping frequency, the resonator's Q-factor is over 5×10^3 at 10 mw. The resonator is immersed in liquid helium and a 40-gram permanent magnet is attached to it. It is claimed that the above paramagnetic amplifier "was successfully used in radar contact of Mercury in June, 1962, and of Venus in the October '62 - January '63 period. In November, 1962, the amplifier helped to establish a radio telegraph communication via Venus." "The authors wish to thank I. A. Kuz'min for his help in developing and building various parts of the amplifier, and also M. M. Dedlovskiy for his participation in operating the amplifier." Orig. art. has: 3 figures.

ASSOCIATION: none

SUBMITTED: 16Jul63

DATE ACQ: 10Feb64

ENCL: 00

SUB CODE: RA, AS

NO REF SOV: 004

OTHER: 001

Card 2/2

ZHABOTINSKIY, M. Ye.; SVERDLOV, Yu. L.

All-union "radio day". Radiotekhnika 19 no.5:3-4 My '64.

Phase instability of multistage frequency multipliers. Ibid.:5-16
(MIRA 17:6)

1. Deystvitel'nyye chleny Nauchno-tekhnicheskogo obshchestva
radiotekhniki i elektrosvyazi imeni Popova.

ACCESSION NR: AP4038597

S/0108/64/019/005/0005/0016

AUTHOR: Zhabotinskiy, M. Ye. (Active member); Sverdlov, Yu. L. (Active member)

TITLE: Phase instability of multistage frequency multipliers

SOURCE: Radiotekhnika, v. 19, no. 5, 1964, 5-16

TOPIC TAGS: frequency multiplication, frequency multiplier, multistage frequency multiplier, frequency multiplier phase instability

ABSTRACT: The intrinsic phase instability of a multistage frequency multiplier; i. e., the instability of a real multiplier placed under ideal external conditions (including excitation by an absolutely stable oscillator), is regarded as a measure of multiplier phase instability. Its maximum is described by:

$$\psi_0 = \sqrt{\sum_{\kappa=1}^s \frac{\delta\psi_{\kappa}^2}{n_1 n_2 \dots n_{\kappa}}}$$

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ACCESSION NR: AP4038597

The general problem is thereby reduced to a particular problem of determining the dispersion of phase of k-th stage $\overline{\delta\psi_k^2}$. A quasi-statistical method is used for determining ψ_0 . Evaluation of phase instability by the conventional two-channel experimental method is, in fact, a determination of the intrinsic phase instability ψ_0 . "In conclusion, the authors wish to sincerely thank Corresponding Member of AN SSSR Yu. B. Kobzarev and Doctor of Physico-Mathematical Sciences Ya. I. Khurgin for their repeated participation in discussions of this problem." Orig. art. has: 6 figures and 35 formulas.

ASSOCIATION: Nauchno-tekhnicheskoye obshchestvo radiotekhniki i elektrosvyazi (Scientific and Technical Society of Radio Engineering and Electrocommunication)

SUBMITTED: 30Dec63

DATE ACQ: 09Jun64

ENCL: 00

SUB CODE: EC

NO REF SOV: 009

OTHER: 003

Card 2/2

ZHABOTINSKIY, Mark Yefremovich; SVERDLOV, Yuriy L'vovich;
GOLOVANOVA, L.V., red.

[Principles of the theory and technique of frequency
multiplication] Osnovy teorii i tekhniki umnozheniia
chastoty. Moskva, Sovetskoe radio, 1964. 326 p.
(MIRA 18:3)

L 25696-66 EWT(1)/EWT(m)/T/EWP(t) IJP(c) AT/JD/JG
SOURCE CODE: UR/0056/65/049/006/1689/1694

ACC NR: AF6002705

AUTHOR: Zhabotinskiy, M. YE.; Rudnitskiy, YU. P.; Tsapkin, V. V.; Ellert, G. V.

ORG: Institute of Radio Engineering and Electronics, Academy of Sciences USSR (Institut radiotekhniki i elektroniki Akademii nauk SSSR) 36
B

TITLE: Transfer of excitation from the crystal lattice to rare earth ions

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 6, 1965, 1689-1694

TOPIC TAGS: polycrystal, ion, cesium compound, uranium compound, rare earth element, excitation spectrum, activated crystal, luminescence spectrum, absorption band, crystal lattice energy

ABSTRACT: The authors have experimentally confirmed the possibility of efficient transfer of excitation energy from the crystal lattice to activator ions, and present the results of a study of such a transfer from uranyl cesium tetrachloride lattice to a rare-earth ion. Polycrystalline uranyl cesium tetrachloride was used, activated by rare earths (other than Ce and Gd) with concentration 0.1--0.5 mol.%. The luminescence spectra and excitation spectra were recorded and the lifetimes measured. The luminescence was excited both directly in the excitation bands of the ions themselves and through excitation of the lattice. The luminescence produced by Pr, Nd, Eu, Ho, Er, and Tm was quite strong, that of Sm weaker, and no luminescence of Tb and Dy was observed. Luminescence of Yb was observed only in the ir region on pumping in the ion absorption band. It is deduced from the excitation spectra that an efficient energy transfer exists between the lattice and the activator ions. Luminescence excited

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ACC NR: AF6002705

through lattice pumping is much more intense than that induced directly in the ion absorption band. The energy transfer is accompanied by appreciable shortening of the lifetime of the excited state of the uranyl, indicating a nonradiative transfer mechanism. Orig. art. has: 6 figures.

SUB CODE: 20/

SUBM DATE: 14 Jun 65/

ORIG REF: 004/

OTH REF: 004

Card 2/2 -10

LETOKHOV, V.S.; VATSURA, V.V.; PUKHLIK, Yu.A.; FEDCTOV, D.I.; KOSOZHICHIN,
A.S.; ZHABOTINSKIY, M.Ye.; DASHEVSKAYA, Ye.I.; KOZLOV, A.N.;
RUVINSKIY, L.G.; VASIN, V.A.; YURGENEV, L.S.; NOVOMIROVA, I.B.;
PETROVA, G.N.; SHCHEDROVITSKIY, S.S.; BELYAYEVA, A.A.; BRYKINA,
L.I.; GLEBOV, V.M.; DRONOV, M.I.; KONOVALOV, M.D.; TARAPIN, V.N.;
MIKHAYLOVSKIY, S.S.; ZHEGALIN, V.G.; ZHABIN, A.I.; GRIBOV, V.S.;
MAL'KOV, A.P.; CHERNOV, V.N.; RATNOVSKIY, V.Ya.; VOROB'YEVA, L.M.;
MILOVANOVA, M.M.; ZARIPOV, M.F.; KULIKOVSKIY, L.F.; GONCHARSKIY,
L.A.; TYAN KHAK SU

Inventions... Avtom. i prib. no.1;78-80 Ja-Mr '65. (MIRA 18:8)

L 2325-66 EWA(k)/FBD/EWT(1)/EEC(k)-2/T/ENP(k)/EWA(m)-2/EWA(h) SCTB /
 IJP(c) WG
 ACCESSION NR: AP5021560 UR/0286/65/000/013/0028/0029
 621.375.8:535.813

AUTHORS: Zhabotinskiy, M. Ye.; Vasnava, G. A. 44 35

TITLE: Method of combining the power of lasers with the coherent operation of each. Class 21, No. 172357 44 5
 2544

SOURCE: Byulleten' izobreteniy i tovarnykh znakov, no. 13, 1965, 28-29

TOPIC TAGS: laser beam control

ABSTRACT: This author certificate presents a method for the coherent lumping of power of individual lasers. To increase the power and directivity of the laser emission, one part of the beam is deflected, distributed between the adjacent lasers (see Fig. 1 of the Enclosure), and directed into phase shifters for scanning the beams. Orig. art. has: 1 figure. [04]

ASSOCIATION: none

SUBMITTED: 11Apr63 ENCL: 01 SUB CODE: EC

NO REF SOV: 000 OTHER: 000 ATD PRESS: 4/07

Card 1/2

L 2325-66

ACCESSION NR: AP5021560

ENCLOSURE: 01

0

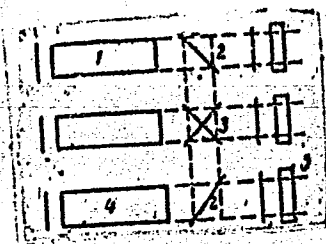


Fig. 1.

1 - Laser; 2 - semitransparent mirror; 3 - crossed mirrors;
4 - laser; 5 - phase shifter.

Card 2/2 *ml*

ACC NR: AP7002662 SOURCE CODE: UR/0109/67/012/001/0056/0062

AUTHOR: Zhabotinskiy, M. Ye.; Frantsesson, A. V.

ORG: none

TITLE: Reflex-type multi resonator quantum paramagnetic amplifiers with active material in all resonators

SOURCE: Radiotekhnika i elektronika, v. 12, no. 1, 1967, 56-62

TOPIC TAGS: paramagnetic amplifier, amplifier design, *quantum device*

ABSTRACT: The possibility of increasing of the bandwidth of reflex-type quantum paramagnetic amplifiers by means of multi-resonator systems with the active material in all resonators is considered. By approximately uniform negative losses and applying contour integration the bandwidth of such systems was evaluated. The three-resonator quantum paramagnetic amplifier was analytically investigated; it was theoretically and experimentally shown that a three-resonator quantum paramagnetic amplifier with an amplification factor of 20db operating in the decimeter wave range (21 cm) provides greater bandwidth than a traveling-wave quantum paramagnetic amplifier. Orig. art. has: 7 figures and 9 formulas.

SUB CODE: 0970/ SUBM DATE: 06Aug65/ ORIG REF: 002/ OTH REF: 006
Card 1/1 UDC: 621.375.029.64

ACC NR: AP7002663

SOURCE CODE: UR/0109/67/012/001/0063/0066

AUTHOR: Zhabotinskiy, M. Ye.; Frantsesson, A. V.

ORG: none

TITLE: Quantum parametric amplifier with three resonators for 21-cm waves

SOURCE: Radiotekhnika i elektronika, v. 12, no. 1, 1967, 63-66

TOPIC TAGS: parametric amplifier, resonant amplifier

ABSTRACT: A parametric amplifier with three resonators has been designed which has an 18-Mc passband at 20-db gain. The miniature resonator system is formed by three parallel 1-mm-wide foil strips $1/4 \lambda$ long and 1.5 mm apart. In both sides of the set of strips are placed two 2 x 9 x 15-mm ruby plates. The strips and ruby plates are mounted along the wide side of the rectangular (4 x 17 mm) waveguide section. One end of each strip is soldered to the waveguide wall; the other end passes through the wall to be used for resonator adjustment and connection to the coaxial cable. A permanent magnet provides a 2000-oe magnetic field. The amplifier operates at 4.2K; helium consumption is 1.3 l per 24 hr. The amplifier was installed and tested in the modulated radiometer system of the

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UDC: 621.375.029.63

ACC NR: AP7002663

Pulkovo radiotelescope. The radiometers had a 1000K-equivalent input noise temperature which was reduced to 120K after installation. Orig. art. has: 7 figures.

SUB CODE: 09/ SUBM DATE: 09Aug65/ ORIG REF: 002/ ATD PRESS: 5111

Card 2/2

S/076/60/034/04/41/042
B010/B009

AUTHORS: Brezhneva, N. Ye., Dobychin, D. P., Zhabrova, G. M.

TITLE: S. Z. Roginskiy (On the Occasion of His 60th Birthday)

PERIODICAL: Zhurnal fizicheskoy khimii, 1960, Vol. 34, No. 4, pp. 939 - 940

TEXT: On March 25, 1960 the excellent scholar Simon Zalmanovich Roginskiy, Corresponding Member of the AS USSR, who has done outstanding research work in the field of catalysis, completed his 60th year of life. Roginskiy graduated from the Dnepropetrovskiy politekhnicheskii institut (Dnepropetrovsk Polytechnic Institute) in 1922 and took up research work in the field of heterogeneous catalysis in the laboratories of the well-known physicochemists, Academician D. P. Kononov and L. V. Pizarzhevskiy. In 1926 Roginskiy collaborated with A. I. Shal'nikov at the Fiziko-tekhnicheskii institut (Physicotechnical Institute) directed by A. F. Ioffe in the preparation of metal sols by condensation. In 1929 he was appointed permanent collaborator of the Institut khimicheskoy fiziki (Institute of Chemical Physics) by Ioffe and N. N. Semenov. In 1932 Roginskiy there became head of the laboratoriya kataliza i topokhimi (Laboratory for Catalysis and Topochemistry), which was incorporated into the Kolloido-

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S. Z. Roginskiy (On the Occasion of His 60th Birthday)

S/076/60/034/04/41/042
B010/B009

elektrokhimicheskiy institut (Colloid Electrochemical Institute) (now the Institut fizicheskoy khimii AN SSSR (Institute of Physical Chemistry AS USSR)) in 1941. During his scientific activities S. Z. Roginskiy published more than 300 papers. From 1937 to 1939 Roginskiy, D. P. Dobychin, and T. F. Tselinskaya did research in the field of the theory of supersaturation. Problems of the reaction course on catalyst surfaces, which Roginskiy had studied in collaboration with O.M. Todes, were published in the monograph "Adsorbtsiya i kataliz na neodnorodnykh poverkhnostyakh" ("Adsorption and Catalysis on Heterogeneous Surfaces") (1948). For his work in the field of efficiency and improvement of military material during the Second World War Roginskiy and S. Yu. Yelovich, G. M. Zhabrova, L. Ya. Margolis, and B. M. Kadenatsi received awards of the Narkom Oborony (People's Commissar for Defense) and the Prezidium Akademii nauk SSSR (Presidium of the Academy of Sciences USSR). In 1946 S. Z. Roginskiy began to deal with the catalytic oxidation of gaseous substances. He collaborated with S. Yu. Yelovich, G.M. Zhabrova, and L. Ya. Margolis and came to formulate the "electron chemical concept of catalysis". In 1954 Roginskiy made some observations, with A. A. Balandin, G. K. Borekov, N. M. Chirkov, and others, on the choice of catalysts. For several years S. Z. Roginskiy systematically investigated catalytic properties of inorganic semiconductors in collaboration with O. V. Krylov, Ye. A. Fokina, and

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S. Z. Roginskiy (On the Occasion of His 60th Birthday)

S/076/60/034/04/41/042
B010/B009

V. M. Frolov. In 1935 Roginskiy and N. Ye. Brezhneva had for the first time in the USSR used radioisotopes for the investigation of chemical reactions. He also developed several isotope methods (in collaboration with N. P. Keyer and M. I. Yanovskiy, respectively). In 1956 S. Z. Roginskiy published the book "Teoreticheskiye osnovy izotopnykh metodov izucheniya khimicheskikh reaktsiy" ("Theoretical Fundamentals of the Isotope Methods for the Study of Chemical Reactions"). Together with A. B. Shekhter Roginskiy investigated chemical reactions in the electric discharge. He collaborated with I. I. Tret'yakov in investigating by electron microscopy the surfaces of metals and disperse bodies. Roginskiy also devoted himself to the training of the scientific staff at the Moskovskiy institut khimicheskogo mashinostroyeniya (Moscow Institute for the Construction of Chemical Machinery). He is an editor of "Problemy kinetiki i kataliza" ("Problems of Kinetics and Catalysis") of which 10 volumes have appeared so far. For his achievements he was twice awarded the Stalin Prize as well as the Order of Red Worker's Banner and several medals. There is 1 figure. ✓

Card 3/3

24.7700
AUTHORS:

Vladimirova, V. I., Yanikev, E. Kh.,
Zhabrova, G. M., Margolis, L. Ya.

68993
S/020/60/131/02/037/071
B004/B007

TITLE:

The Relationship Between Electric Conductivity and the Work
Function of Modified Zinc Oxide

PERIODICAL:

Doklady Akademii nauk SSSR, 1960, Vol 131, Nr 2, pp 342 - 345
(USSR)

ABSTRACT:

In many cases, the experimental data on the electric conductivity of semiconductors contradict the conceptions of the position of the Fermi level. The present paper is intended to characterize the position of the Fermi level by the amount of the work function of an electron. For this purpose, the activation energy E_a of electric conductivity and the change in the work function ϕ_0 and $ZnSO_4$ into ZnO are measured. For the purpose of introducing Na and Li, the ZnO was saturated with the oxalates of these metals and heated up to $450 - 500^\circ$. Thorium was precipitated from thorium hydrate onto the surface of ZnO , $ZnSO_4$ was adsorbed as a basic salt from a solution of this salt. Also with Th and $ZnSO_4$, the sample was heated to 450° . The ZnO with the admixtures was

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The Relationship Between Electric Conductivity and the
Work Function of Modified Zinc Oxide

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B004/B007

subjected to X-ray- and electron diffraction studies. Table 1 shows the measurements of activation energy and the change in the work function as a result of admixtures. The activation energy of pure ZnO was very low (0.08 ev). The admixtures led to an increase of the activation energy as well as to a decrease of electric conductivity. The electric resistance of the samples at 350° decreased in the following order: $ZnO+Li_2O > ZnO+Na_2O > ZnO+ZnSO_4 > ZnO+ThO_2 > ZnO$. From measurement of electric conductivity alone the conclusion might have been drawn that all admixtures used are acceptors and reduce the Fermi level to the level of the valence band. Measurement of the work function, on the other hand, shows that Li and Na decrease the work function, and that $ZnSO_4$ and ThO_2 increase it. The X-ray measurement carried out by N. A. Shishakov et al. and M. Ya. Kushnerev revealed no changes in the lattice constant of the modified zinc oxide, so that no conclusions could be drawn as to the formation of solid solutions. The different influence exerted by admixtures was explained by their different distribution on the surface and in the interior

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The Relationship Between Electric Conductivity and the Work Function of Modified Zinc Oxide

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S/020/60/131/02/037/071
B004/B007

of the sample. ZnO was saturated with Na and Li, whereas ZnSO₄ and ThO₂ were precipitated only on the surface. Measurement of the change in electric conductivity alone is therefore not sufficient in order to carry out a unique determination of the position of the Fermi level on the surface of modified catalysts. For the purpose of recognizing the true relationship between catalytic activity and electric conductivity, it is necessary to investigate admixture distribution on the surface and in the interior of the semiconductor. There are 1 table and 13 references, 7 of which are Soviet.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences, USSR)

PRESENTED: November 4, 1959, by M. M. Dubinin, Academician

SUBMITTED: October 30, 1959

Card 3/3

S/020/60/133/004/040/040XX
B004/B067

AUTHORS: Roginskiy, S. Z., Corresponding Member of the AS USSR,
Yanovskiy, M. I., Lu Pey-chzhan, Gaziyeu, G. A., Zhabrova,
G. M., Kadenatsi, B. M., and Brazhnikov, V. V.

TITLE: Rapid Chromatographic Method of Measuring the Adsorption
Isotherms of Gases and Vapors

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 133, No. 4,
pp. 879-881

TEXT: Since in heterogeneous catalysis the dimensions of the specific surface are of great importance, the authors attempted to develop a rapid method of determining the specific surface. Their studies were based on a paper by J. N. Wilson (Ref. 1) where the relation between the chromatographic curve and the form of the isotherm is theoretically studied. The results were compared with those of the ordinary vacuum technique. Fig. 1 shows the scheme of the experimental apparatus. The gas analyzer was an ionization detector on the basis of Pm^{147} (Ref. 5). The adsorption of heptane was measured. Nitrogen and sometimes argon were used as carriers.

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Rapid Chromatographic Method of Measuring the Adsorption Isotherms of Gases and Vapors S/O20/60/133/004/040/040XX
B004/B067

The height of the steps recorded corresponds to the initial concentration C_0 of the adsorbate. The desorption curves recorded on blowing the pure carrier gas through the column permit the calculation of the isothermal line of adsorption. In a variation of this method, the column is not saturated, but the sample is periodically injected into the column through which the carrier gas flows. The experiment then lasts only 10-15 min. On the assumption of an immediately established equilibrium and the absence of longitudinal diffusion, the adsorption was calculated from the following equations: $f(C) = \omega k S_1 / u g$ (2), where $f(C)$ is the amount of the substance adsorbed by 1 g of adsorbent (mmole/g) in which C is the equilibrium concentration; k is the constant of the detector (mmole/cm³.cm); u is the speed of the recorder tape; g is the weight of the adsorbent (g); and S_1 is the area below the desorption curve. The following adsorbents were used: refractory diatomite bricks, silica gel of the type E (Ye), nickel-hydroxide gel, nickel catalyst, MgO produced from $Mg(NO_3)_2$, $ZnO + 14.5 ZnSO_4$, and carbon black. The values for MgO, silica gel Ye, nickel hydroxide, and diatomite were in good agreement with those obtained by the vacuum technique. For adsorbents with a large number of very narrow pores (active

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Rapid Chromatographic Method of Measuring the Adsorption Isotherms of Gases and Vapors S/020/60/133/004/040/040XX
B004/B067

coal) the results were unsatisfactory. The range of application of the chromatographic method must be further studied. The authors thank I. Ye. Neymark and M. A. Piontrovskiy for preparing the coarse-pored silica gel Ye and nickel-hydroxide samples. There are 4 figures, 1 table, and 5 references: 2 Soviet, 1 US, 1 British, 1 Dutch, and 1 Hungarian.

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute of Physical Chemistry of the Academy of Sciences USSR)

SUBMITTED: January 28, 1960

Legend to Fig. 1: 1: cylinder with carrier gas; 2: bubbler with adsorbate; 3: chromatographic column; 4: gas analyzer; 5: recording potentiometer; 6-10: fine-regulating valves; 11: four-way cock; 12-15: rheometers.

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3

S/020/60/133/006/031/031XX
B004/B067

AUTHORS: ~~Zhabrova, G. M.,~~ Vladimirova, V. I., and Vinogradova, O. M.

TITLE: Mechanism of the Effect of Modifying Additions on the Selectivity of Zinc Oxide With Respect to the Dehydrogenation and Dehydration of Isopropyl Alcohol.

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 133, No. 6, pp. 1375-1378

TEXT: In Refs. 1-5 the authors had found that the sorption of micro-impurities strongly influences the selectivity and catalytic activity of ZnO during the dehydrogenation and dehydration of isopropyl alcohol. Therefore, they attempted to explain this effect by comparing the data of reaction kinetics, chemisorption, and electron characteristics in ZnO containing certain admixtures. ZnO was modified with Na₂O and Li₂O by soaking the oxide with alkali oxalates, and by heating to 450 - 500°C. Modifying with ZnSO₄ was done by soaking ZnO with sulfate solution. The specific surface was determined by adsorption of n-heptane by a

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Mechanism of the Effect of Modifying
Additions on the Selectivity of Zinc Oxide
With Respect to the Dehydrogenation and
Dehydration of Isopropyl Alcohol

S/020/60/133/006/031/031XX
B004/B067

chromatographic method developed at the catalysis laboratory of the authors' association, as well as by adsorption of krypton according to Brunauer, Emmet, and Teller. The results obtained by both methods were in good agreement. The effect of the admixtures on the dehydrogenation of isopropyl alcohol is shown in Fig. 1. During dehydration, the admixtures showed the contrary effect: Na₂O suppressed, and ZnSO₄ increased, the rate of this reaction. The following values were obtained for the desorption of acetone from the surface of ZnO: pure ZnO: 32 kcal/mole; ZnO with 14.5% ZnSO₄: 41 kcal/mole, ZnO with 6.2% Na₂O: 10 kcal/mole. Fig. 3 shows the work function $\Delta\phi$ as depending on the content of admixtures. By simultaneously measuring the work function and the electrical conductivity in the presence of vapors of isopropyl alcohol, acetone, water, hydrogen, or propylene at 10 mm Hg and 100°C the following was found: Sorption of isopropyl alcohol and acetone lowers the work function; other vapors had no effect. Hence, a donor-acceptor process is assumed for the dehydrogenation of isopropyl alcohol, which proceeds in the following

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Mechanism of the Effect of Modifying
Additions on the Selectivity of Zinc Oxide
With Respect to the Dehydrogenation and
Dehydration of Isopropyl Alcohol

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B004/B067

stages: $(\text{CH}_3)_2\text{CHOH} \longrightarrow (\text{CH}_3)_2\text{CHOH}^+ + e$ (I); $(\text{CH}_3)_2\text{CHOH}^+ \longrightarrow (\text{CH}_3)_2\text{CO}^+ + \text{H}_2$
(II); $(\text{CH}_3)_2\text{CO}^+ + e \longrightarrow (\text{CH}_3)_2\text{CO}$ (III). The slow stage III limits the rate
of reaction. Dehydration, however, is regarded as an acid-type process
characterized by proton exchange between the catalyst and the reacting
molecule. F. I. Vilesov, A. N. Terenin, E. Kh. Yenikev, L. Ya. Margolis,
and S. Z. Roginskiy are mentioned. There are 3 figures, 1 table, and 15
references: 12 Soviet, 2 US, 1 British, and 1 German. ✓

ASSOCIATION: Institut fizicheskoy khimii Akademii nauk SSSR (Institute
of Physical Chemistry of the Academy of Sciences USSR)

PRESENTED: March 21, 1960 by M. M. Dubinin, Academician

SUBMITTED: March 8, 1960

Card 3/3

S/195/61/002/005/004/027
E040/E485

AUTHORS: Zhabrova, G.M., Shibanova, M.D.

TITLE: Investigation of oxide catalysts during their preparation and thermal treatment by the emanation method

PERIODICAL: Kinetika i kataliz, v.2, no.5, 1961, 668-673

TEXT: Further progress of studies concerning catalytically-active solid materials requires the use of very sensitive experimental techniques for the study of surface properties, crystal lattice defects, changes in the mobility of the atoms or ions constituting such crystals, etc. The emanation method developed by L.S.Kolovrat-Chervinskiy (Ref.1: Tr. radiyevoy eksped. Ross. Akad. nauk, no.9-10, 1918) and subsequently improved by other workers offers great possibilities in detecting hidden phase and chemical transformations in solid phases, changes in specific surface, establishing the conditions of crystal lattice, etc. The method was used previously by the present authors and S.Z.Roginskiy in studying the topochemical processes of the decomposition of magnesium and zinc hydroxides and the

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S/195/61/002/005/004/027
EO40/E485

Investigation of oxide catalysts ...

relationship was established between the emanation coefficient and the conditions under which the processes were allowed to proceed. The same experimental technique was used in examining the preparation of the oxides of the following metals, all of which are widely used as industrial catalysts: nickel, magnesium, aluminium, zirconium and thorium. The method consists essentially in introducing into the test materials of a radioisotope of radium or thorium, emitting during its decay an inert radioactive gas: radon, thoron or actinon. The degree of emanation observed for the test material is then correlated with the required physical property. Full details are given of the method used for introducing Th^{228} into the test oxides. Preliminary studies showed that the method of catalyst preparation can influence both its specific surface and emanation coefficient: $\text{Al}(\text{OH})_3$ precipitated with ammonia and NaOH was found to have, respectively: specific surfaces of 34 and 300 m^2/g and thoron emanation coefficients of 22 and 98%. Variation of the emanation capacity of the hydroxides of Zn, Ni, Al, Mg, Zr and Th was examined during their dehydration in the temperature range of 100 to 1000°C. The test results in the form of Card 2/4

Investigation of oxide catalysts ...

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curves representing the variation of emanating capacity with temperature were compared with thermographic curves prepared for the same specimens. The maximum of emanation capacity was found to correspond for all the test oxides to the temperature of initial endothermic dehydration. An examination of the dependence of the emanation coefficient of various oxide catalysts on their specific surface showed that, at room temperature, it is linear in character. An attempt is made to formulate the mechanism of thoron emanation from the various oxides. The emanation method was used in evaluating the stability of the crystal lattice of some of the catalytic oxides (ZnO) at temperatures up to 1200°C in the presence of a small addition of other oxides of metals of different valency (lithium oxide in the concentration of 0.5 at%). The results of the investigation show that the emanation method can be applied to studies of a large variety of problems associated especially with the condition of the active catalytic surface in the various stages of the preparation of oxide and similar solid state catalysts. V.G.Khlopin, I.Ye.Starik, M.S.Merkulova and M.Ya.Kushnerev are mentioned in the paper for their contributions in this field. There are 5 figures, 1 table
Card 3/4

Investigation of oxide catalysts ...

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E040/E485

and 14 references: 8 Soviet-bloc and 6 non-Soviet-bloc.

The reference to an English language publication reads as follows:

Ref.2: O. Hahn. Applied Radiochemistry, 1936: J. Chem. Soc., v.259,
2, 1949.

ASSOCIATION: Institut khimicheskoy fiziki AN SSSR
(Institute of Chemical Physics AS USSR)

Card 4/4

GORDEYEVA, V.A.; YEGOROV, Ye.V.; ZHABROVA, G.M.; KADENATSI, B.M.;
KUSHNEREV, M. Ya.; ROGINSKIY, S.Z.

Use of ionizing radiation in the study of the decomposition
processes of copper and nickel oxalates. Dokl. AN SSSR 136
no.6:1364-1367 F '61. (MIRA 14:3)

1. Institut fizicheskoy khimii AN SSSR. 2. Chlen-korrespondent
AN SSSR (for Roginskiy).

(Copper oxalate)
(Nickel oxalate)
(Radiation)

S/844/62/000/000/115/129
D207/D307

AUTHORS: Roginskiy, S. Z., Zhabrova, G. M., Gordeyeva, V. A.,
yegorov, Ye. V., Kadenatsi, B. M. and Kushnerev, M. Ya.

TITLE: The use of ionizing radiation in investigation of topo-
chemical processes

SOURCE: Trudy II Vsesoyuznogo soveshchaniya po radiatsionnoy khi-
mi. Ed. by L. S. Polak. Moscow, Izd-vo AN SSSR, 1962,
668-673

TEXT: A study was made of the differences between the topochemical
processes of thermal decomposition and of decomposition, using 0.6
- 2 Mev electrons. The substances decomposed were copper oxalate
($\text{CuC}_2\text{O}_4 \cdot 1/2\text{H}_2\text{O}$) and nickel oxalate ($\text{NiC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) which were pre-
pared by precipitating nitrate solutions with oxalic acid at 50°C ;
the samples were in the form of thin layers of powder. Thermal de-
composition in vacuum at 280°C yielded 85% Cu + 15% Cu_2O and 95%
Ni + 2.0% NiO + 3% undecomposed residue. Thermal decomposition in
air at about 300°C yielded 50% CuO + 50% Cu_2O and 100% NiO. Elec-

Card 1/2

The use of ionizing ...

S/844/62/000/000/115/129
D207/D307

tron irradiation (3.6×10^9 - 3.3×10^{10} rad) at 100°C yielded usually pure metals with large (10 - 40%) residues undecomposed oxalates; the metal yield increased with the radiation dose. Strong preliminary irradiation (at least 0.6×10^9 rad) accelerated strongly the subsequent thermal decomposition in vacuum. The mechanisms of thermal and electron-bombardment decomposition were the same; holes generated by heat or irradiation neutralized partly or completely the double charged oxalate ions which then moved to the surface and were emitted as CO_2 ; electrons also generated by heat or irradiation neutralized the doubly charged metal cations which yielded pure metals. Oxides were formed as an intermediate stage in the production of pure metals; in air, oxides were produced also by oxidation of the pure metal products. The essential difference between electron bombardment and heat lay in the greater carrier-generation efficiency of the former. There are 2 figures and 1 table.

ASSOCIATION: Institut fizicheskoy khimii AN SSSR (Institute of Physical Chemistry, AS USSR); Institut khimicheskoy fiziki AN SSSR (Institute of Chemical Physics, AS USSR)

Card 2/2

11600

39631

S/195/62/003/004/001/002
E075/E436

AUTHORS: Zhabrova, G.M., Kadenatsi, B.M., Zvonov, N.V.,
Yegorov, Ye.V., Azizov, T.S., Batalov, A.A.,
Gordeyeva, V.A., Glazunov, P.Ya.

TITLE: Preparation of finely divided metals and oxides by
radiation

PERIODICAL: Kinetika i kataliz, v.3, no.4, 1962, 610-613

TEXT: A possibility was investigated of preparing metals and
oxides in a finely divided form by irradiation of $Zr(OH)_4$,
 $Al(OH)_3$, $Fe(OH)_3$, Ni and Cu oxalates and basic copper carbonate
with accelerated electrons having the energy of 0.8 Mev. The
temperature of the samples during irradiation (1 to 2 g) did not
exceed 40 to 50°C. Thermal decomposition at 400 to 500°C was
also carried out for comparison with the irradiated materials.
The decomposition of all the compounds commenced at radiation
doses exceeding 10^8 rads and was intense at 10^9 to 10^{10} rads.
At the latter doses the compounds were almost completely
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S/195/62/003/004/001/002
E075/E436

Preparation of finely ...

decomposed. It was shown that the specific surface of the metals and oxides prepared by the irradiation method exceeds in most cases that of the samples prepared by the usual high-temperature pyrolysis. An especially marked advantage was noticed for the radiolysis of Cu and Ni oxalates. The surface area of the oxalate decomposition products consisting predominantly of metals was sometimes 10 or more times that of the decomposition products obtained by vacuum pyrolysis. Radiolysis of $Zr(OH)_4$ and $Fe(OH)_3$ gives dispersed oxides having considerable surface areas. $Al(OH)_3$ is an exception, Al_2O_3 produced by the radiolysis having a similar surface area to that of Al_2O_3 obtained by pyrolysis. The metals and oxides prepared by radiolysis may find application as low temperature catalysts and adsorbents. There are 2 figures and 2 tables.

ASSOCIATIONS: Institut khimicheskoy fiziki AN SSSR
(Institute of Chemical Physics AS USSR)
Institut atomnoy energii im. I.V.Kurchatova AN SSSR
(Institute of Atomic Energy imeni I.V. Kurchatov
AS USSR)

Card 2/3

Preparation of finely ...

S/195/62/003/004/001/002
E075/E436

Institut fizicheskoy khimii AN SSSR
(Institute of Physical Chemistry AS USSR)

SUBMITTED: March 15, 1962

X

Card 3/3

38521

S/186/62/004/003/017/022
E075/E436

55500

AUTHORS: Jech, Č., Zhabrova, G.M., Roginskiy, S.Z.,
Shibanova, M.D.

TITLE: The change of emanation capacity and the evolution of
surface gaseous marker during dehydration of hydroxides

PERIODICAL: Radiokhimiya, v.4, no.3, 1962, 355-364

TEXT: The authors studied the processes of dehydration of metal
hydroxides leading to changes in their structure and specific
surface, using the classical emanation method with Th²²⁸, as well
as the method developed by one of the present authors (Č. Jech,
Radioisotopes in Scientific Research. (Proc. First UNESCO Internat.
Confer)., v.2, 491. London, Pergamon Press, 1958). In the
latter method inert radioactive marker gases are introduced into a
solid by bombarding its surface with the gaseous ions in a high
frequency electric discharge. Thermogravimetric and X-ray
analyses were also used. The hydroxides studied were
Zn(OH)₂, Ni(OH)₂, Mg(OH)₂, Al(OH)₃, Zr(OH)₄ and Th(OH)₄.
The hydroxides were heated up to 600°C. The radioactive methods
indicated the initiation of the dehydration processes with great
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The change of emanation ...

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E075/E436

sensitivity. The methods were equally sensitive for indicating changes on dehydration of the hydroxides, of which the oxides could form bulk solid solutions with ThO_2 as well as of those that did not form the solid solutions. It was established that the extreme points of the emanation capacity and evolution of radioactive gases occurred at the same temperature as the beginning of the endothermic process of dehydration. The position of the maximum of the endothermic effect on the thermograms, due to the dehydration proceeding in the bulk of the hydroxide, corresponded to a higher temperature than that of the maximum radioactivity. This is explained by the formation of surface solid solutions on the hydroxides, with the individual elements and radioactive gases. It was found that the emanation method was very sensitive to crystalline changes, some of which were not detected by the thermogravimetric method. The authors concluded that the use of the radioactive methods could be extended to the investigation of structural changes occurring during topochemical processes in dispersed solid systems not forming bulk solid solutions with Th(OH)_4 or ThO_2 . There are 9 figures and 2 tables.

SUBMITTED: June 1, 1961
Card 2/2

JARBOVA, G. M. [Zhabrova, G. M.]; EGOROV, E. V. [Yegorov, Ye. V.]

Regularities of sorbtion and iron exchange in the amphoteric
oxides and hydroxides. Analele chimie 17 no.1:7-22 Ja-Mr '62.

ZHABROVA, G.M.; KADENATSI, B.M.; AZIZOV, T.S.; GORDEYEVA, V.A.; GLAZUNOV, P.Ya.;
GEZALOV, A.A.

Radiation method of preparation of highly dispersed metals and oxides.
Izv.AN SSSR.Otd.khim.nauk no.9:1690-1692 S '62. (MIRA 15:10)

1. Institut khimicheskoy fiziki AN SSSR i Institut fizicheskoy khimii
AN SSSR.

(Metallic oxides)

(Colloids)

(Radiation)

11.12/10

44562
S/020/63/148/001/021/032
B144/B186

AUTHORS: Vladimirova, V. I., Zhabrova, G. M., Kadenatsi, B. M.,
Kazanskiy, V. B., Pariyskiy, G. B.

TITLE:

Joint action of radiation and oxide catalysts on the
dehydrogenation of cyclohexane

PERIODICAL:

Akademiya nauk SSSR. Doklady, v. 148, no. 1, 1963, 101-104

TEXT: The radiation effect on catalytic systems is studied in the
dehydrogenation of cyclohexane activated by SiO_2 , Al_2O_3 , MgO , ZrO_2 , ZnO ,
or NiO . After a vacuum pretreatment of the catalyst at $400^\circ C$, cyclo-
hexane vapors were led over it. The determinations concerned: 1) the
catalytic properties after irradiation with 0.8 Mev electrons at room
temperature, dose $2.4 \cdot 10^6$ rad/sec, energy absorption $1.4 \cdot 10^9$ rad; 2) the
paramagnetic properties after gamma irradiation with Co^{60} at $-196^\circ C$,
dose 3200 mcu, energy absorption $5 \cdot 10^6 - 1 \cdot 10^8$ rad. 1) A low-temperature
dehydrogenation of cyclohexanone took place. Good results were obtained

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Joint action of radiation and ...

with SiO_2 , Al_2O_3 and aluminosilicate with a H_2 evolution of 0.58, 0.565, and 0.405 mg/g. ZrO_2 , MgO and ZnO were hardly active and NiO was completely inactive. On SiO_2 , the conversion percentage increased with increasing irradiation dose. Thus, the oxides that proved effective were just those that are ineffective under normal catalytic conditions, even at high temperatures; while the otherwise active ZnO and NiO proved ineffective in catalysis combined with radiation. 2) The e.p.r. spectra revealed additional lines in the irradiated samples which are attributed to the formation of adsorbed free radicals, i.e. C_6H_7 . This effect was most marked on SiO_2 and increased with increasing dose. Similar signals were observed for aluminosilicate and Al_2O_3 . Weak additional lines were observed in MgO and ZrO_2 , but their origin was not cleared up. No lines at all were detected for irradiated ZnO and NiO , either with or without adsorption of cyclohexanone. The different activity of the catalysts studied in oxide catalysis combined with irradiation is explained by

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Joint action of radiation and ...

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their different electron properties. In dielectrics and poor semi-conductors the radiation-induced ionization is stronger, since the electrons and holes formed are longer trapped and the paramagnetic centers are resistant at low temperatures, while they vanish so rapidly in ZnO and NiO that no e.p.r. signals could be recorded. There are 2 figures and 1 table.

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute of Chemical Physics of the Academy of Sciences USSR)

PRESENTED: July 30, 1962, by V. N. Kondrat'yev, Academician

SUBMITTED: July 19, 1962

Card 3/3

X

ZHABROVA, G. M; SHIBANOVA, M. D.

"Use of the 'Emaniermethode' in investigating the decomposition process of metallic hydroxides and the effect of the admixtures on the structural properties of the oxides."

Report to be submitted for the 5th Intl. Symposium on the Reactivity of Solids (IUPAC), Munich, West Germany, 2-8 Aug 1964.

SHIBANOVA, M.D.; ZHABROVA, G.M.

Use of the emanation method in studying the structure of zinc oxide and nickelous oxide with added lithium and gallium oxides.
Dokl. AN SSSR 155 no. 4:912-915 Ap '64. (MIRA 17:5)

1. Institut khimicheskoy fiziki AN SSSR. Predstavleno akademikom V.N.Kondrat'yevym.

ZHABROVA, Galina Mikhailovna, doktor khim. nauk; CHERNIKOVA, V.K.,
red.

[Catalysis] Kataliz. Moskva, Znanie, 1964. 45 p. (Novoe
v zhizni, nauke, tekhnike. XI Seriya: Khimii, no.6)
(MIRA 17:9)

"APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R001964520006-8

APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R001964520006-8"

Card 2/3

Abstract has: Abstract

spectrometric analysis." Orig. art. has: 5 figures and 2 tables.

ASSOCIATION: Institut khimicheskoy fiziki AN SSSR (Institute of Chemical

SUBMITTED: 12Nov63

ENCL: 00

SUE CODE: OC

NO RZ7 Sov. 007

OTHER: 008

Card 3/3

L 24499-66 EWT(m)/EWT(j)/T RM
ACC NR: AP6002166 SOURCE CODE: UR/0195/65/006/006/1019/1024

AUTHOR: Zhabrova, G. M.; Roginskiy, S. Z.; Shibanova, M. D. 23

ORG: Institute of Chemical Physics, AN SSSR (Institut khimicheskoy fiziki AN SSSR)

TITLE: Variation in the emanating power of oxide catalysts during chemisorption and catalysis

SOURCE: Kinetika i kataliz, v. 6, no. 6, 1965, 1018-1024

TOPIC TAGS: chemisorption, thorium compound, zinc oxide, catalysis

ABSTRACT: The emanation method, which is very sensitive to all kinds of surface and structural changes in solids, was used to study the state of the surface during the endothermic catalytic process of decomposition of isopropyl alcohol on oxide catalysts. The variation of the emanating power of the catalysts ThO_2 , ZrO_2 , MgO , ZnO , $\text{ZnO} + 0.22\% \text{Na}_2\text{O}$, $\text{ZnO} + 2\% \text{ZnSO}_4$, labeled with radiothorium, was measured during chemisorption of gases and vapors formed by the decomposition of this alcohol. Changes in emanation during chemisorption of acetone and water on the surface of oxide catalysts were found to be due to the formation of surface chemical compounds. Introduction of modifying admixtures into ZnO , which change the selectivity of the catalytic process and affect the rate of chemisorption and desorption of acetone, causes a change in the emanating power of zinc oxide samples. This change may serve as a cri-

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Card 1/2 UDC: 541.124 : 546.3-31-44

L 24499-66

ACC NR: AP6002166

terion for the formation of the surface chemical compounds. Orig. art. has: 6 figures.

SUB CODE: 07/ SUBM DATE: 18Jul64/ ORIG REF: 005/ OTH REF: 001

Card 2/2 LL

ZHABROVA, G.M.; ROGINSKIY, S.Z.; SHIBANOVA, M.D.

Change of the emanating capacity of oxide catalysts in chemisorp-
tion and catalysis. Kin. i kat. 6 no. 6s1018-1024, N-D '65
(MIRA 19:1)

1. Institut khimicheskoy fiziki AN SSSR. Submitted July 18,
1964.

VLADIMIROVA, V.I.; ZHABROVA, G.M.; KADENATSI, B.M.

Particular features of the radiation-induced catalytic
conversion of methanol at a small surface coverage. Kin. i
kat. 6 no. 6:1112-1113 N-D '65 (MIRA 19:1)

1. Institut khimicheskoy fiziki AN SSSR. Submitted June 9,
1965.

L 1327-66 EWT(m)/EPF(c)/EPF(n)-2/EWP(j)/EWA(h)/EWA(l) GG/RM
 UR/0020/65/164/002/0361/0364
 44SS 44SS 44SS 44SS
 ACCESSION NR: AP5024005
 AUTHOR: Vladimirova, V. I.; Zhabrova, G. M.; Kadenatsi, B. H.; Kazanskiy, V. B.;
 Pariyskiy, G. B.

TITLE: Radiation-catalytic conversion of methanol 1

SOURCE: AN SSSR. Doklady, v. 164, no. 2, 1965, 361-364

TOPIC TAGS: methanol, gamma radiation, radiation chemistry, electron paramagnetic resonance, free radical, silica gel, alumina, aluminum silicate, semiconductor, heterogeneous catalysis

ABSTRACT: The authors had established earlier that during the combined action of ionizing radiation and solids of different electronic properties, the dielectric-type oxides SiO₂, Al₂O₃, and aluminum silicate SiO₂·Al₂O₃, in which paramagnetic centers and adsorbed radicals were detected, displayed the greatest activity in the conversion of cyclohexane in the adsorbed layer, whereas semiconductors and metals, which had no paramagnetic centers or radicals, were inactive. In order to determine the scope of these findings, a similar study was made on the radiation-catalytic decomposition of methanol in the adsorbed layer at 20°C. Co⁶⁰ gamma radiation being used (dose rate, 4.3 x 10¹⁶ ev/g·sec; adsorbed radiation dose, 8.2 x 10¹⁹ to

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ACCESSION NR: AP5024005

3

7×10^{21} ev/g). It was found that as in the case of the heterogeneous radiolysis of cyclohexane, SiO_2 , Al_2O_3 , and $\text{SiO}_2 \cdot \text{Al}_2\text{O}_3$ were the most effective catalysts for methanol; the radiation-chemical yield and rate of formation of hydrogen, formaldehyde, and ethylene glycol on silica gel were ten times as high as in the case of homogeneous radiolysis. The electron spin resonance spectra of the radicals formed on SiO_2 and Al_2O_3 were recorded. Oxides with semiconducting properties such as ZnO showed a considerably lesser catalytic activity. The results confirm the relationship established earlier between the radiation-catalytic activity of solids and their electronic properties. The high radiation-chemical yields of hydrogen, formaldehyde, and ethylene glycol during decomposition of methanol on silica gel, aluminum oxide, and aluminum silicate are apparently closely related to the processes of transfer of the energy of ionizing radiation absorbed by these solids to the molecules adsorbed on the surface. Orig. art. has: 1 figure, 1 table. [14]

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute of Chemical Physics, Academy of Sciences, SSSR)

SUBMITTED: 04Feb65

4465
ENCL: 00

SUB CODE: ac,gc

NO REF SOV: 005

OTHER: 004

ATD PRESS: 4103

Card 2/2

YEKH, Ch.; ZHABROVA, G.M.; ROGINSKIY, S.Z.; SHIBANOVA, M.D.

Emanation capacity and the liberation of the surface gas tag in
the thermal decomposition of copper, nickel, and thorium oxalates.
Dokl. AN SSSR 164 no.6:1343-1346 0 '65.

(MIRA 18:10)

1. Institut khimicheskoy fiziki AN SSSR i Institut fizicheskoy
khimii Akademii nauk Chekhoslovatskoy Sotsialisticheskoy
Respubliki. 2. Chlen-korrespondent AN SSSR (for Roginskiy).

ZHABROVA, R.V.

Justification of the standard depth of soil freezing based on observations.
[Trudy] NII osn. no.52:63-68 '63. (MIRA 17:2)

ZHABROVA, Z.V., inzh.; ZNAMENSKIY, A.K.; DERZHAVINA, M.F., inzh.

Use of elastic yarn in the hosiery industry. Tekst.prom. 19 no.4:
44-50 Ap '59. (MIRA 12:6)

1. Zamestitel' glavnogo inzhenera fabriki "Krasnoye znanya" (for
Znamenskiy).
(Hosiery industry) (Elastic fabrics)

ZHABROV, G.M.; KAZANSKIY, V.B.; VLADIMIROVA, V.I.; KADENATSI, B.M.; PARIYSKIY,
G.B.

Radiation-catalytic conversions of cyclohexane. Neftekhimiya 4 no.5:
753-762 S-0 '64. (MIRA 18:1)

1. Institut khimicheskoy fiziki AN SSSR.

ZHABREV, D.V.; LARSKAYA, Ye.S.

Disseminated organic matter in the Tertiary sediments of
Daghestan. Trudy VNIGNI no.33:167-180 '62.

(MIRA 18:12)

ZHABREV, D.V.; LANSKAYA, Ye.S.

Effect of subsurface thermodynamics on the conversion of discriminated organic matter in sedimentary rocks. Geol. nefti i gaza 9 no.8:16-30 Ag '65. (MIRA 18:8)

1. Vsesoyuznyy nauchno-issledovatel'skiy geologorazvedochnyy neftyanoy institut, Moskva.

NALIVKIN, V.D.; DEDEYEV, V.A.; IVANTSOVA, V.V.; KATS, Z.Ya.; KRUGLIKOV, N.M.;
LAZAREV, V.S.; SVETCHKOV, G.P.; CHERNIKOV, K.A.; SHABLINSEAYA, N.V.;
Prinimal učastiye: ZHABREV, I.P.; ROZANOV, L.N.; SOFRONITSKIY, P.A.;
KHAIN, V.Ye.; SIMONENKO, T.N.; SOKOLOV, V.N.; YAKOVLEV, O.N., gidrogeolog

[Comparative analysis of the oil and gas potential and tectonics
of the West Siberian and Turan-Scythian platforms.] Sravnitel'nyi
analiz naftogazonosnosti i tektoniki Zapadno-Sibirskoi i Turano-
Skiiskoi plit. Leningrad; Nedra, 1965. 322 p. (Leningrad.
Vsesoiuznyi neftianoi nauchno-issledovatel'skii geologorazvedochnyi
institut. Trudy, no.236) (MIRA 18:6)

ZHABREV, I.P.

Development of fold structure of the Western Kuban foredeep trough.
Trudy KF VNII no.1:166-189 '59. (MIRA 16:9)
(Kuban-Azor Lowland—Folds (Geology))

ZHABIEV, I.P.; BURYAK, V.N.

Some problems of the Middle Pliocene stratigraphy of the Taman
Peninsula. Trudy KF VNI no.1:95-99 '59. (MIRA 16:9)
(Taman Peninsula--Geology, Stratigraphic)

EGOIAN, V.L. [Yegoyan, V.L.]; JABREV, I.P. [Zhabrev, I.P.]; KOTOV, V.S.;
ROSTOVIEV, K.O. [Rostovtsev, K.O.]

Distribution laws of oil and gas deposits in the Mesozoic
deposits of western Ciscancasus. Analele geol geogr 17 no.4:
50-57 0-D '63.

ZHABREV, I.P.

Some problems of the formation of oil and gas pools in northwestern
Ciscaucasia. Trudy VNIGNI no.27:48-54 '60. (MIRA 17:3)

ZHABREV, I.P.: DVORTSOVA, A.A.

Characteristics of oil and gas distribution in Neogene deposits in
the western part of the southern edge of the western Kuban trough.
Trudy KF VNII no.6:23-37 '61. (MIRA 15:2)
(Kuban-Azov Lowland--Petroleum geology)
(Kuban-Azov Lowland--Gas, Natural--Geology)

YEGOYAN, V.L.; ZHABREV, I.P.; KOTOV, V.S.; ROSTOVTSSEV, K.O.

Characteristics of the distribution of gas and oil pools in
Mesozoic sediments of western Ciscaucasia. Geol. nefti i
gaza 6 no.7:20-24 J1 '62. (MIRA 15:6)

1. Krasnodarskiy filial Vsesoyuznogo nauchno-issledovatel'skogo
neftegazovogo instituta.

(Caucasus, Northern--Petroleum geology)

(Caucasus, Northern--Gas, Natural--Geology)

ZHABREV, I.P.

Cycles in the accumulation of Miocene sediments in the western part
of the southern edge of the western Kuban trough. Trudy KF VNII
no.6:277-284 '61. (MIRA 15:2)
(Kuban-Azov Lowland--Sediments (Geology))

ZHABREV, I.P.

Possible changes in conditions governing the formation of hydrocarbons
in the course of the earth's evolution. *Biul.MOIP.Otd.geol.* 35
no.4:7-12 J1-Ag '60. (MIRA 14:4)
(Petroleum geology)

ZHABREV, I.P.

Geological development of the frontal trough in the western Kuban
Lowland. Trudy Kf VIII no.3:143-154 '60. (MIRA 13:11)
(Kuban Lowland--Geology)

ZHABREV, V. A.; MOISEYEV, V. V.

"Studying self-diffusion of sodium ions in aluminosilicate glasses over a temperature range from 100 to 250° C.

report submitted for 4th All-Union Conf on Structure of Glass, Leningrad, 16-21 Mar 64.

ZHABREV, I.P.; DVORTSOVA, A.A.; FEYGIN, M.V.

Oil and gas potentials of the frontal trough of the western Kuban
Lowland. Trudy K² VNII no.3:155-179 '60. (MIRA 13:11)
(Kuban Lowland--Petroleum geology)
(Kuban Lowland--Gas, Natural--Geology)