Motulevich, G.P.

AUTHORS: Motulevich, G.P. and Shubin, A.A. 51-5-13/26

TITLE: Determination of the Optical Constants of Metals in the Infrared Region. (Opredeleniye opticheskikh postoyannykh metallov v infrakrasnoy oblasti)

PERIODICAL: Optika i Spektroskopiya, 1957, Vol.2, Nr 5, pp.633-636 (USSR)

ABSTRACT: Study of the elliptical polarisation of light, produced on reflection of linearly-polarised light from a metallic mirror, makes it possible to determine the complex refractive index $n - i\varkappa$. In the region of frequencies where the optical constants are determined by the conduction electrons, the constants n and $\varkappa$ are related to the conduction electron concentration by

$$N = 0.112 \frac{n^2 + \varkappa^2}{\lambda^2} \cdot 10^{22}$$

where N = the conduction electron concentration, λ = the wavelength of light in microns. This relationship applies only when the following inequality is satisfied:

$$\omega_0^2 \gg \omega^2 \gg \nu_0^2$$

Card 1/3 where ω_0 = frequency corresponding to the limit of quantum

Determination of the Optical Constants of Metals in the Infrared Region. 51-5-13/26

absorption and ν = the number of collissions of electrons with the lattice. In this region N is independent of λ. To find n and $\varkappa$ by this method it is sufficient to know the phase difference between p and s-components of the reflected light and the azimuth ρ. The apparatus used is shown in Fig.1, where S is the source of infra-red radiation, M is a monochromator, Π is a polariser, m_1, m_2, m_3 and m_4 are mirrors of the studied metal, A is an analyser and B is a bolometer. The optical constants of of silver, lead and tin were measured. These metals were prepared as mirrors by vacuum deposition on glass. The results for silver are shown in Fig.2. Curve 1 gives the refractive index (n) and curve 2 the coefficient of absorption ($\varkappa$). Fig.2 contains also results obtained by other workers. Table 1 shows the values of n, $\varkappa$ and N for silver. The latter quantity is constant in the wavelength region studied and its value is about 5.2×10^{22}. For comparison the authors quote the concentration of atoms in silver as 5.9×10^{22}. Tables 2 and 3 give the results for

Card 2/3

SOV/137-58-7-16029

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 7, p 299 (USSR)

AUTHOR: Motulevich, G. P., Shubin, A. A.

TITLE: The Polarization Method of Measurement of the Optical Constants of Metals in the Infrared Region (Polyarizatsionnyy metod izmereniya opticheskikh postoyannykh metallov v infrakrasnoy oblasti)

PERIODICAL: Fiz. sb. L'vovsk. un-t, 1957, Nr 3 (8), pp 95-96

ABSTRACT: The investigation of optical constants of metals in the infrared region makes it possible to obtain a series of values that are actually indispensible for the electronic theory of metals. For the measurement the m-multiple reflection is used, which magnifies the phase displacement, enhances the precision in the measurement of the azimuth and permits an advance into the region of longer wave lengths. The experiments were carried out on a four-mirror apparatus. The optical constants λ (μ), n, x, $N \cdot 10^{-22}$ of Ag, Pb, and Sn mirrors manufactured by evaporation in a vacuum were measured.

V. O.

Card 1/1

1. Metals--Optical properties 2. Infrared optical systems --Materials

MOTULEVICH, G.P.

46-2-21/23

AUTHOR: Motulevich, G.P. and Fabelinskiy, I. L.

TITLE: An optical method of calibration of sound radiators at low acoustic frequencies. (Opticheskiy metod absolyutnoy graduirovki akusticheskikh izluchateley na nizkoy zvukovoy chastote)

PERIODICAL: "Akusticheskiy Zhurnal" (Journal of Acoustics), 1957, Vol.3, No.2, pp. 205-206 (U.S.S.R.)

ABSTRACT: In their previous work (1) the authors have shown the dependence of the refractive index n on density ρ at low acoustic frequencies and have obtained exact values of $\rho\frac{\partial n}{\partial \rho}$; these results permit the application of the method to the realisation of a purely optical method of calibration of sound sources of arbitrary construction, which radiate a low frequency into a closed, small as compared with the wavelength, volume. The source to be calibrated is connected to a heavy tube with end glass plates and filled with a liquid, the $\rho\frac{\partial n}{\partial \rho}$ of which is well known (water, benzene). The tube is placed in one of the arms of the Jamain, Mach-Zender or Michelson interferometer. The other arm contains a similar

Card 1/3

46-2-21/23

An optical method of calibration of sound radiators at low acoustic frequencies. (Cont.)

tube with a liquid which compensates for the heavy absorption of light in the first tube. When the source radiates, the harmonic variation of pressure or density in the first arm produces harmonic light attenuation effects. When the pressure changes are smooth the contrast of the interference image will first increase and then disappear at the moment when the difference in pressure is that given by eq. (5). If, therefore, the source driving voltage or current changes smoothly, the interferometer picture will disappear at various pressures Δp_1, Δp_2, etc. so that a graph of absolute calibration may be constructed. The accuracy of measurement is determined in practice by the accuracy of measurement of $\rho \frac{\partial n}{\partial p}$, all other quantities in eq.(5) being determined much more accurately. The experimentally-obtained values for $\rho \frac{\partial n}{\partial p}$ were: water 0.337 ± 0.006; benzene 0.53 ± 0.02, taken at the light wavelength λ = 5461 Å and at room temperature. As shown in (1) $\rho \frac{\partial n}{\partial p}$ depends very little both on wavelength and temperature.

There are 3 Slavic references.

Card 2/3

46-4-2-5/20

AUTHORS: Zaytsev, V.P., Motulevich, G.P. and Fabelinskiy, I.L.

TITLE: Construction and Absolute Calibration of a Magneto-Electric Acoustic Generator (Konstruktsiya i absolyutnaya graduirovka magnito-elektricheskogo akusticheskogo izluchatelya)

PERIODICAL: Akusticheskiy Zhurnal, 1958, Vol IV, Nr 2, pp 137-142 (USSR)

ABSTRACT: The present paper describes a generator which works inside a closed space whose dimensions are small compared with the acoustic wavelength and the method of absolute calibration of this generator is given. Errors in this calibration do not exceed 1-2%. The generator is shown in Fig 1. Change of pressure in the vessel 4 filled with liquid is produced by a piston 1 which is rigidly connected with an induction coil 2 which is placed in the radial field of a permanent magnet 3. The vessel 4 has two plane-parallel windows 7. To observe motion of the piston and to measure its displacement, an aperture was made through the centre of the magnet. Through this aperture, without touching the magnet, an aluminium rod passes, the rod is rigidly fixed to

Card 1/3

46-4-2-5/20

Construction and Absolute Calibration of a Magneto-Electric Acoustic Generator

the piston. A small mirror 5 is attached to the top of the aluminium rod. Particular attention was paid to effective sealing between the piston and the walls (see Fig 2). The natural frequency of the generator was 185 c/s but the receiver was used at 50 c/s. The construction used was found to produce a sinusoidal change of pressure in the vessel 4 when a sinusoidal current was passed through the coil. The piston displacement was found to be proportional to the current in the coil. This makes it possible, after suitable calibration, to find the pressure amplitude in the vessel from the value of the current in the coil. A short theory of the generator is given. Its calibration was carried out as follows. The piston displacement was measured very accurately by using the mirror 5 of Fig 1 as one of the mirrors of a Michelson interferometer (Fig 3). The piston displacement was varied by passing a known d.c. or a.c. current through the energizing coil 2. From the proportionality of the current and piston displacement the

Card 2/3

46-4-2-5/20

Construction and Absolute Calibration of a Magneto-Electric Acoustic Generator

calibration curves were obtained (Fig 5). The authors thank G.S. Landsberg for valuable advice. There are 5 figures and 4 Soviet references.

ASSOCIATION: Fizicheskiy Institut imeni P.N. Lebedeva, AN SSSR, Moskva (Physics Institute imeni P.N. Lebedev, Academy of Sciences of the USSR, Moscow)

SUBMITTED: March 20, 1957

Card 3/3

1. Generators—Calibration 2. Calibration—Test methods 3. Calibration—Test results

SOV/56-34-3-40/55

AUTHORS: Motulevich, G. P., Shubin, A. A.

TITLE: On the Rôle of Collisions Between the Electrons in Metals in the Infrared Spectral Region (O roli mezhelektronnykh soudareniy v metallakh v infrakrasnoy oblasti spektra)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1958, Vol. 34, Nr 3, pp. 757 - 758 (USSR)

ABSTRACT: The contribution of the collisions between the electrons to the surface impedance of the metal is unimportant at low frequencies. Yet this contribution increases with increasing frequency, L. P. Pitayevskiy (Reference 2) and R. N. Gurzhi (Reference 3) calculated this increase quantitatively for the infrared region of the spectrum. According to these elaborate investigations, the collisions between the electrons lead to the occurrence of an additional member of the kind B/λ^2 in the real part of surface impedance; B denotes in this connection a factor which does not depend on the wavelength λ of the light. The measurements of the optical constants of silver carried out by the authors, show

Card 1/3

SOV/ 56-34 - 3-40/55

On the Rôle of Collisions Between the Electrons in Metals in the Infrared Spectral Region

that this additional member is essential within the additional spectral region (1 - 6μ). A diagram demonstrates the dependence of the real part of R of the surface impedance R on λ. The experimental points match well with the curve $(c/\pi)(R_0 + B/\lambda^2)$, in which case $(c/\pi)R_0 = 0.96 \cdot 10^{-2}$ and $(c/.)B = 1.40 \cdot 10^{-2}\mu^2$. R_0 and B do not depend on λ in this connection and c denotes the light velocity. The measurements of the real part of the surface impedance really allow the explanation of the rôle of the collisions between the electrons. The terms derived for the clearly marked anomalous skin-effect can be applied for silver within the spectral region from 1 to 6μ for the determination of the concentration N of the conducting electrons and of the velocity v of the electrons on the Fermi-surface. The reflection of the electrons on the surface of the metal is assumed to be diffuse in this case. The authors obtained the value $v = 2.4 \cdot 10^8$ cm/sec. for silver. The measurements of the optical constants of tin and lead within the spectral region from 1 to 6μ showed that the contribution of the collisions

Card 2/3

SOV/56-34-3-40/55

On the Rôle of Collisions Between the Electrons in Metals in the Infrared Spectral Region

between the electrons to the real part of the surface impedance is essential for these two metals, too. But with these metals, the term derived for a distinctly marked skin effect must not be used, which makes the evaluation of the results more complicated. The calculation of the surface impedance and of the optical constants of the metal within the range $\omega \sim \nu_0$ is far less reliable. ω denotes the frequency of light in this connection and ν_0 the frequency of the collisions of electrons with the lattice. The evaluation of the upper limit of N as obtained by the same authors previously (Reference 4), is too accurate and is precized here. But these data, too, can be considered only approximately correct, since the theoretical formulae used in their calculation are not quite reliable. There are 1 figure and 5 references, 4 of which are Soviet.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute imeni P.N.Lebedev AS USSR)

SUBMITTED: December 7, 1957

Card 3/3

MOTULEVICH, G. P.

21(0),24(0) PR PHASE I BOOK EXPLOITATION SOV/32

Akademiya nauk SSSR. Fizicheskiy institut

Issledovaniya po eksperimental'noy i teoreticheskoy fizike; [sbornik] (Studies on Experimental and Theoretical Physics; Collection of Articles) Moscow, Izd-vo AN SSSR, 1959. 304 p. Errata slip inserted. 2,300 copies printed.

Ed.: I. L. Fabelinskiy, Doctor of Physical and Mathematical Sciences; Eds. of Publishing House: A. L. Chernyak and V. G. Berkgaut; Tech. Ed.: Yu. V. Rylina; Commission for Publishing the Collection in Memory of Grigoriya Samuilovich Landsberg: I. Ye. Tamm (Chairman), Academician; M. A. Leontovich, Academician; P. A. Bazhulin, Doctor of Physical and Mathematical Sciences; S. L. Mandel'shtam, Doctor of Physical and Mathematical Sciences; I. L. Fabelinskiy, Doctor of Physical and Mathematical Sciences; F. S. Landsberg-Baryshanskaya, Candidate of Physical and Mathematical Sciences; and G. P. Motulevich (Secretary), Candidate of Physical and Mathematical Sciences.

PURPOSE: This book is intended for physicists and researchers engaged in the study of electromagnetic radiations and their role in investigating the structure and composition of materials.

Card 1/6

Studies on Experimental (Cont.) SOV/3250

COVERAGE: The collection contains 30 articles which review investigations in spectroscopy, sonics, molecular optics, semiconductor physics, nuclear physics, and other branches of physics. The introductory chapter gives a biographical profile of G. S. Landsberg, Professor and Head of the Department of Optics of the Division of Physical Technology at Moscow University, and reviews his work in Rayleigh scattering, combat gases, spectral analysis of metals, etc. No personalities are mentioned. References accompany each article.

TABLE OF CONTENTS:

Card 2/6

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AVAILABLE: Library of Congress TM/ec
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76994
SOV/56-37-6-34/55

AUTHOR: Motulevich, G. P.

TITLE: Relation Between the Optical Constants of Metals and Their Micro-Characteristics

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 6, pp 1770-1774 (USSR)

ABSTRACT: A theoretical analysis was made of the relation between the optical characteristics of metals and their microscopic characteristics. A model was considered in which, for the electron, the effective number of collisions was as follows:

$$\nu_{eff} = \nu^{el} + \nu^{ee} + \nu^{n}. \quad (1)$$

The following assumptions were made: (1) The conductivity electrons can be considered as Fermi gas. (2)

Card 1/3

Relation Between the Optical Constants of Metals and Their Micro-Characteristics

76994
SOV/56-37-6-34/55

The Fermi surface is the medium. (3) The diffusive reflection of the electron from metal surface is taking place. For the real and imaginary part of the surface impedence the following relations hold true:

$$cX/\pi = 4\varkappa/(n^2+\varkappa^2) = 1{,}34\cdot 10^{11}(1+p^2G)/\sqrt{N}\lambda, \qquad (3)$$

$$cR/\pi = 4n/(n^2+\varkappa^2) = 0{,}75\beta + 3{,}54\cdot 10^{-5}\cdot N^{-1/2}(\nu^{ef}+\nu^{ee}+\nu^{n}) - p^2\beta D \qquad (4)$$

where

$$p = 2{,}59\cdot 10^{-11}\beta\sqrt{N}\lambda, \quad G = 0{,}0865 + 0{,}216q + 0{,}125q^2,$$
$$D = 0{,}215 + 0{,}748q + 0{,}750q^2 + 0{,}216q^3, \quad q = 2{,}045\cdot 10^{-5}\nu_{eff}/\sqrt{N}\beta. \qquad (5)$$

Card 2/3

Relation Between the Optical Constants of Metals and Their Micro-Characteristics

76994
SOV/56-37-6-34/55

(cf. R. B. Dingle, Physica, 19, 348, 1953; V. L. Ginzburg and G. P. Motulevich, Uspekhi Fiz. Nauk, 55, 469, 1955). The analysis shows that the measurement of the optical constants of metals in the infrared region over a wide range of wave lengths, in conjunction with measurements of the static conductivity of the same samples at various temperatures, should yield the density of the conductivity electrons, the electron velocity on the Fermi surface, and the frequency of interelectronic collisions. A procedure for the treatment of the experimental data was suggested on the basis of the theoretical data (cf. V. P. Silin, Zhur. Eksp. i Teoret. Fiz., 33, 1282, 1957; R. I. Gurzhi, ibid., 35, 965, 1958). V. L. Ginzburg, V. P. Silin, and I. L. Fabelinskiy participated in the discussion of this subject. There are 8 references, 7 Soviet, 1 Dutch.

ASSOCIATION: P. N. Lebedev Physics Institute, Academy of Sciences USSR, USSR (Fizicheskiy institut imeni P. N. Lebedev Akademii nauk SSSR, SSSR)

SUBMITTED: July 10, 1959

Card 3/3

85346

S/120/60/000/005/016/051
E032/E514

24.3900

AUTHORS: Golovashkin, A.I., Motulevich, G.P. and Mubin, A.A.

TITLE: Measurement of the Optical Constants of Metals at Low Temperatures

PERIODICAL: Pribory i tekhnika eksperimenta, 1960, No.5, pp.74-76

TEXT: The optical system of the instrument is shown in Fig.1. A parallel beam of light passing through the polarizer Π_1 enters a system of two plane and parallel mirrors L under investigation (in the figure the plane of the mirrors has been rotated through 90° for the purposes of the illustration). After four reflections in this mirror system, the light strikes an auxiliary mirror L' which reflects it back at an angle of 4° to the original direction and the plane of reflection lies in the plane of the mirrors L. In this way the light experiences a further four reflections at the mirrors under investigation. The mirror L' is identical with the mirrors L and a correction is introduced for the phase difference due to this mirror. It was found that the correction is negligible compared with the phase difference Δ due to the mirrors under investigation after four reflections. On leaving the set of parallel mirrors L, the light passes through a further polarizer

Card 1/2

85346

S/120/60/000/005/016/051
E032/E514

Measurement of the Optical Constants of Metals at Low Temperatures

Π2 which is rotated at a frequency of 9 cps. It is then passed through a monochromator M and is detected by the bolometer B. The bolometer signal is amplified by a tuned amplifier. The system of mirrors L - L' is placed in a container which is then lowered into a dewar filled with liquid nitrogen or liquid helium. The first measurements obtained with the aid of this apparatus were concerned with aluminium at liquid nitrogen and room temperatures in the wavelength region 0.8-7 μ. The determination of the micro-characteristics of aluminium from the results obtained is described by the present authors in Ref.4. There are 3 figures and 4 Soviet references.

ASSOCIATION: Fizicheskiy institut AN SSSR (Physics Institute AS USSR)

SUBMITTED: July 16, 1959

Card 2/2

GOLOVASHKIN, A.I.; MOTULEVICH, G.P.; SHUBIN, A.A.

Determining microscopic characteristics of aluminum from measurements of its optical constants and its conductivity. Zhur. eksp. i teor. fiz. 38 no.1:51-55 Jan '60. (MIRA 14:9)

1. Fizicheskiy institut im. P.N.Lebedeva AN SSSR.
(Aluminum--Optical properties) (Aluminum--Electrical properties)

BELYANKIN, A.G.; MOTULEVICH, G.P.; CHETVERIKOVA, Ye.S.; YAKOVLEV, I.A.; IVERONOVA, V.I., prof., red.; KUZNETSOVA, Ye.B., red.; KRYUCHKOVA, V.N., tekhn. red.

[Laboratory manual on physics] Fizicheskii praktikum. Pod red. V.I.Iveronovoi. Moskva, Fizmatgiz, 1962. 956 p. (MIRA 16:5)

(Physics—Laboratory manuals)

24.5500

37814

S/120/62/000/002/046/047
E039/E435

AUTHORS: Golovashkin, A.I., Motulevich, G.P.

TITLE: A sensitive small inertia thermal resistance for helium temperatures

PERIODICAL: Pribory i tekhnika eksperimenta, no.2, 1962, 182-185

TEXT: A thermal detector is described which is based on the superconductivity transition. The method of preparation is simple and permits the construction of small inertia detectors of high sensitivity. The detector is obtained by simultaneously evaporating lead and copper from separate evaporators onto a single surface in vacuo. The properties of the alloys formed have been investigated previously. In general the detector consists of a strip about 7 cm long, 0.5 mm wide and 0.05 to 0.15 μ thick; its characteristics are controlled by (1) its resistance at room temperature R_o (determined by its thickness) and (2) the ratio of its resistance at room temperature to its resistance at the temperature of liquid nitrogen $\alpha = R_o/R_{78}$ (determined by its composition and thickness). R_o is usually 500 to 2500 Ω. When $\alpha < 1.06$ the region of maximum

Card 1/2

A sensitive small inertia ... S/120/62/000/002/046/047
E039/E435

sensitivity lies below 1.5°K and when $\alpha > 1.6$ above 4.2°K. The sensitive region is displaced to lower temperatures when the lead content is reduced and also when the thickness is decreased. Sensitivity is determined by the value of dR/dT; for an extended transition it is 150 to 200 Ω/°K and for a sharp transition 1000 to 3000 Ω/°K. The value of the temperature coefficient of resistance $R^{-1}\,dR/dT = 2$ to $4°K^{-1}$. Normal working current is about 2 to 5 mA and the voltage sensitivity is about 10 V/°K. The detector may be used in fields up to 2 K Oe providing the displacement of the sensitive region is taken into account. It is particularly suitable for the investigation of fast transition processes as its inertia is 100 times lower than that of the best carbon and phosphor bronze detectors. Its thermal capacity is about 3×10^{-9} cal/°K. There are 5 figures.

ASSOCIATION: Fizicheskiy institut AN SSSR (Physica Institute AS USSR)

SUBMITTED: July 18, 1961

Card 2/2

MOTULEVICH, G.P.; SHUBIN, A.A.

Determining the microcharacteristics of indium by measuring the optical constants in the infrared region and the specific conductivity. Zhur. eksp. i teor. fiz. 44 no.1: 48-52 Ja '63. (MIRA 16:5)

1. Fizicheskiy institut imeni P.N.Lebedeva AN SSSR.
(Indium—Optical properties) (Indium—Electric properties)
(Collisions (Nuclear physics)

S/056/63/044/002/002/065
B102/B186

AUTHORS: Golovashkin, A. I., Motulevich, G. P.

TITLE: Determination of the microcharacteristics of lead from measurements of its optical constants and specific conductivity

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 44, no. 2, 1963, 398-404

TEXT: The optical constants (i.e. n and $\varkappa$ of the refractive index $n' = n - i\varkappa$) of lead were measured in the range 0.7-12 μ at room temperature, and in the range 0.8-11 μ at liquid-nitrogen temperature. The measuring apparatus has been described previously (Optika i spektroskopiya, 2, 633, 1957; PTE, 5, 74, 1960); both worked with a d-c arc discharge as light source and a NaCl prism monochromator. A selenium stack (8 films) was used as polarizator, and a germanium bolometer as receiver. The test objects were high-purity lead layers of 0.6 to 1.6 μ condensed in vacuo onto polished glass plates. Measurements of the static conductivity and the density showed that these properties of the layers investigated were

Card 1/3

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equal to those of bulk lead. The residual resistance of the layers was 0.93% of that at room temperature; Θ_D was 86°K. $R_{393}/R_{77.4}$ = 4.14 (bulk lead: 4.15). In order to determine the microcharacteristics the experimental results were analyzed specially for both temperatures. Skin effect and the quantum corrections for both electron-phonon (e-ph) and electron-electron (e-e) collisions were taken into account. For room temperature, the relations

$$\lambda^2 \frac{\varkappa^2 - n^2}{(n^2 + \varkappa^2)^2} = \frac{\pi mc^2 \cdot 10^8}{e^2} \frac{1}{N} = \frac{0{,}112 \cdot 10^{22}}{N}, \quad (1)$$

$$\lambda \frac{2n\varkappa}{(n^2 + \varkappa^2)^2} = \frac{mc \cdot 10^4}{2e^2} \frac{\nu_{\text{эфф}}}{N} = 5{,}93 \cdot 10^8 \frac{\nu_{\text{эфф}}}{N}. \quad (2)$$

were obtained; λ is the light wavelength in μ, m the mass of the free electron and e its charge;

$$\nu_{eff} = \nu^{e-ph} + \nu^{e-e} + \nu^{e-i} + \nu^{e-s},$$

where ν^{e-i} denotes the electron-impurity collision frequency and ν^{e-s} that of electrons with the surface; $\nu^{e-s} = 0.75\beta\, N/3.54 \cdot 10^{-5}$ where

$\beta = v/c$ and the conduction electron concentration $N = 4.0\cdot10^{22}$ cm^{-3}; with $v = 3.5\cdot10^{8}$ cm/sec for the electron velocity at the Fermi surface one obtains $\nu^{e-s} = 0.5\cdot10^{14}$ sec^{-1}. ν^{e-ph} is obtained as $2.37\cdot10^{14}$ sec^{-1}, and $\nu^{e-i} = 0.023\cdot10^{14}$ sec^{-1}. $\nu^{e-e}_{class.} = \nu^{e-e}/(1+\hbar\omega/2\pi kT)^2) = 0.08\cdot10^{14}$ sec^{-1}. The mean free path of the electron is $l = 1.1\cdot10^{-6}$ cm for $\lambda = 5\ \mu$, and the skin depth is $\delta = 3.2\cdot10^{-6}$ cm. A similar analysis was made for 77.4°K. The results were as follows: $N = 3.9\cdot10^{22}$ cm^{-3}; $v = 2.3\cdot10^{8}$ cm/sec; $\nu^{e-ph}_{class.} = 5.7\cdot10^{13}$ sec^{-1}; $\nu^{e-e}_{class.} = 0.006\cdot10^{13}$ sec^{-1}; $\nu^{e-i} = 0.23\cdot10^{13}$ sec^{-1}; $l = 3.3\cdot10^{-6}$ cm and $\delta = 2.7\cdot10^{-6}$ cm for $\lambda = 5\ \mu$. According to the theory, ν^{e-e} should be $\sim T^2$; here it was found to be $\sim T^3$. There are 4 figures and 2 tables.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute imeni P. N. Lebedev of the Academy of Sciences USSR)

SUBMITTED: July 7, 1962

L 33198-66 EWT(1)/EWT(m)/EWP(t)/ETI IJP(c) JD/GG

ACC NR: AR6016217 SOURCE CODE: UR/0058/65/000/011/D072/D072

AUTHOR: Motulevich, G. P.

TITLE: Connection between the optical constants and microcharacteristics of a metal in the case of a weakly pronounced anomalous skin effect

SOURCE: Ref. zh. Fizika, Abs. 11D557

REF SOURCE: Tr. Komis. po spektroskopii. AN SSSR, t. 3, vyp. 1, 1964, 428-436

TOPIC TAGS: dielectric constant, metal property, skin effect, kinetic equation

ABSTRACT: A connection is obtained between the reciprocal of the effective complex dielectric constant and the microcharacteristics of a metal in the case of a weakly pronounced anomalous skin effect for the isotropic case (polycrystals) and for cubic single crystals. The calculation was made by the classical kinetic equation method. The assumptions made are satisfied by metals with low Debye temperature (Pb, In, Sn, etc.), and also by metals or alloys having large residual resistance. The experimental data were reduced for Pb and Sn. [Translation of abstract]

SUB CODE: 20

Card 1/1

GOLOVASHKIN, A.I.; MOTULEVICH, G.P.

Optical and electric properties of tin. Zhur. eksp. i teor. fiz. 46 no.2:460-470 F '64. (MIRA 17:9)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

ACCESSION NR: AP4042370 S/0056/64/047/001/0064/0072

AUTHORS: Golovashkin, A. I.; Motulevich, G. P.

TITLE: Optical properties of tin at helium temperatures

SOURCE: Zh. eksper. i teor. fiz., v. 47, no. 1, 1964, 64-72

TOPIC TAGS: tin, optical propagation, skin effect, internal photoeffect, phonon

ABSTRACT: Continuing earlier measurements of the optical constants of tin at 293 and 78K (ZhETF v. 46, 460, 1964), the authors measured the optical constants of tin at T = 4.2K in the spectral interval 0.9--12 μ and repeated the measurements at 78 and 293K. The results at room and at nitrogen temperatures agreed with the earlier data. The apparatus used for the measurement of the optical constant was the same as before, and is described in detail as modified for the low-temperature measurements. The test results show that tin is

ACCESSION NR: AP4042370

subject to a weakly pronounced anomalous skin effect over the entire investigated range of temperatures. The surface losses amount to 15--20% of the total losses even at T = 4.2K. The contributions of the internal photoeffect to the optical constant could be neglected. The temperature dependence of the frequency of the collision of electrons with phonons in the presence of a light quantum of high energy was determined. The experimental results confirm the theoretical results obtained on the basis of the quantum-kinetic equation. It is concluded that the volume absorption in tin, connected with the generation of an entire phonon spectrum, remains large at helium temperatures. The quantitative agreement between the experimental results and the data obtained on the basis of the quantum-kinetic equation is assumed to be good. Orig. art. has: 6 figures, 6 formulas, and 3 tables.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute, Academy of Sciences SSSR)

ACCESSION NR: AP4042370

SUBMITTED: 11Feb64 ENCL: 02

SUB CODE: OP, MM NR REF SOV: 005 OTHER: 004

3/5

ACCESSION NR: AP4042370 ENCLOSURE: 01

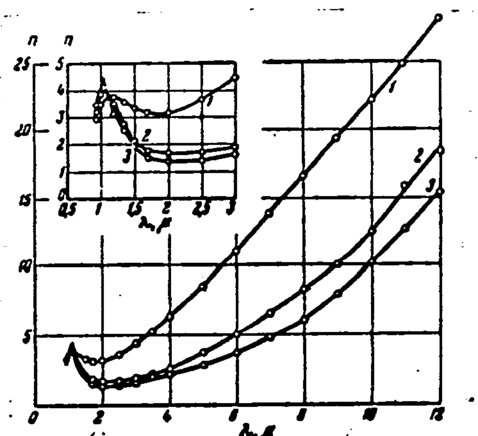
Optical constants of tin

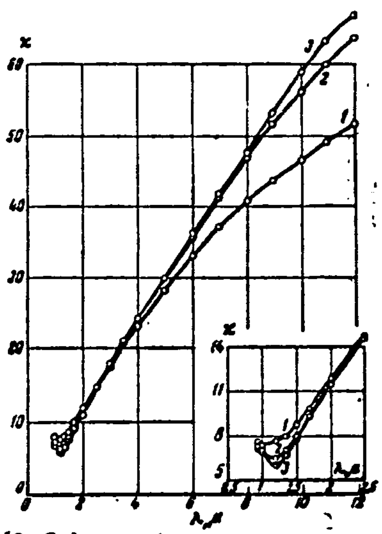
λ, μ	T = 293° K		T = 78° K		T = 4,2° K	
	n	κ	n	κ	n	κ
0,93	3,15	7,28	3,43	7,17	2,95	7,62
0,99	3,44	7,34	3,02	6,94	3,70	7,15
1,2	3,76	7,63	3,53	6,45	3,05	5,98
1,35	3,57	8,04	2,76	6,09	2,55	6,64
1,5	3,31	8,67	2,09	7,98	1,90	7,80
1,7	3,13	9,88	1,75	9,29	1,51	9,35
2,0	3,10	11,8	1,65	11,4	1,38	11,4
2,5	3,63	14,8	1,69	14,6	1,39	14,6
3,0	4,41	17,8	1,88	18,0	1,58	18,0
3,5	5,27	20,5	2,13	21,1	1,95	21,1
4,0	6,19	23,2	2,40	24,2	2,13	24,2
5,0	8,49	28,5	3,75	29,7	2,75	30,0
6,0	11,0	33,1	4,97	35,5	3,73	35,8
7,0	13,8	37,1	6,51	41,4	4,89	41,6
8,0	16,6	40,6	8,17	47,0	6,05	47,4
9,0	19,3	43,8	10,0	51,7	7,90	53,3
10,0	22,0	46,4	12,4	55,8	10,1	58,7
11,0	24,8	49,0	15,7	59,8	12,6	63,4
12,0	27,8	51,6	18,2	63,8	15,3	67,0

Card 4/5

ACCESSION NR: AP4042370

ENCLOSURE: 02





Wavelength dependence of the real (left) and imaginary (right) components of the complex refractive index at different temperatures

Card 5/5

L 10727-65 EWT(1)/EEC(t) IJP(c)/SSD/AS(mp)-2/ESD(t)/ASD(a)-5/AFMDC/AFWL/
ESD(dp)/ESD(gs)

S/0056/64/047/003/0840/0847

ACCESSION NR: AP4046396

B

AUTHORS: Motulevich, G. P.; Shubin, A. A.

TITLE: Influence of the shape of the Fermi surface of gold on the optical constants and on the Hall effect

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 47, no. 3, 1964, 840-847

TOPIC TAGS: gold, Fermi surface, thin film, Hall effect, electrical conductivity, optical constant

ABSTRACT: To ascertain the degree to which nonsphericity of the real Fermi surface influences the optical properties and the Hall effect, these quantities were measured in the 1--12 μ spectral region in simultaneously prepared gold films. A formula is derived for estimating the contributions made by electrons on different portions of the Fermi surface to the optical constants and to the Hall effect.

Card 1/3

L 10727-65

ACCESSION NR: AP4046396

2

The use of this formula necessitated also the measurement of the static conductivity at 293 and 78K, the ratio of the residual resistance to the resistance at room temperature, and the density of the samples. The gold was evaporated from tungsten vessels on polished glass to film thickness 0.5--1.0 micron. The optical constants were measured by a polarization method employing four-fold reflection, using previously described apparatus (Optika i spektroskopiya v. 2, 633, 1957). All other quantities were measured by conventional means. The combined measurement of the optical constants and of the Hall effect on the same samples makes it possible to determine the mean velocities of the electrons and their mean effective masses on different portions of the Fermi surface. From this it is deduced that small deviations of the Fermi surface from sphericity have a small effect on the optical constant, but a noticeable effect on the Hall emf. "We are grateful to V. L. Ginzburg and L. V. Keldy*sh for a discussion of the results of this work." Orig. art. has: 2 figures, 5 formulas, and 3 tables.

Card 2/3

L 10727-65

ACCESSION NR: AP4046396

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute, Academy of Sciences SSSR)

SUBMITTED: 03Apr64 ENCL: 00

SUB CODE: SS, OP NR REF SOV: 009 OTHER: 006

Card 3/3

MOTULEVICH, G.P.; SHUBIN, A.A.; SHUSTOVA, O F.

Effect of periodic structure on the optical properties of aluminum. Zhur.eksp. i teor.fiz. 49 no.5:1431-1434 N '65.
MIRA 19:1)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

L 15889-66 EWT(1)/EWT(m)/T/EWP(t) IJP(c) JD

ACC NR: AT6002491 SOURCE CODE: UR/0000/65/000/000/0001/0009

AUTHOR: Ginzburg, V. L.; Motulevich, G. P.; Pitayevskiy, L. P.

ORG: Physics Institute im. P. N. Lebedev (Fizicheskiy institut)

57
B+1

TITLE: Optical properties of polyvalent metals and interelectronic interaction

SOURCE: AN SSSR. Fizicheskiy institut. Doklady, 1965. Opticheskiye svoystva polivalentnykh metallov i mezhduelektronnoye vzaimodeystviye, 1-9

TOPIC TAGS: electron, gold, aluminum, tin, lead, electron interaction, metal crystal, permittivity, absorption band

ABSTRACT: In polyvalent metals (Al, Sn, Pb), on the one hand, the approximation of weakly bound electrons is adequate, but on the other hand, the concentration of optical electrons N_{opt} is much lower than that of valence electrons N_{val} (by definition, N_{opt} figures in the expression for the permittivity $\epsilon \simeq -4 \frac{e^2 N_{opt}}{m\omega^2}$ for optical frequencies ω lying outside the absorption band). This difference can be explained by the influence of interelectronic interaction, since in the theory of the Fermi liquid for crystalline metals $N_{opt} \neq N_{val}$. At the same time, for liquid metals, the equality $N_{opt} \simeq N_{val}$ should take place, and this is indeed observed in practice. Authors are grateful to M. Ya. Azbel' and D. Paye for

L 15889-66

ACC NR: AT6002491

a discussion of the problems touched upon in the present note. Orig art. has: 2 tables and 3 formulas.

SUB CODE: 07, 20 SUBM DATE: none / ORIG REF: 013 / OTH REF: 004

Card 2/2

ACC NR: AP6000196 EWT(m)/EWP(w)/T/EWP(t)/EWP(b) IJP(c) JD

SOURCE CODE: UR/0056/65/049/005/1431/1434

AUTHOR: Motulevich, G. P.; Shubin, A. A.; Shustova, O. F.

ORG: Physics Institute im. P. N. Lebedev, AN SSSR (Institut fiziki AN SSSR)

TITLE: The effect of periodic structure on the optical properties of aluminum

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 5, 1965, 1431-1434

TOPIC TAGS: aluminum, optic property, refractive index, ir phenomenon, skin effect, conduction electron, electron collision, metal crystal, metal crystallization, light polarization, electron interaction, periodic system

ABSTRACT: The authors measured the real and imaginary parts of the refractive index of crystalline and amorphous aluminum in the infrared region. In both cases, layers of 99.99% pure aluminum were evaporated in vacuum on a glass substrate. A crystalline or amorphous structure was obtained by varying the cooling rate. The measurements were made by a polarization technique, using four-color reflection of light from the investigated surface, as described by the authors earlier (Optika i spektroskopiya, v. 3, 361, 1957). The measurements have shown that the skin effect exhibits a slightly anomalous character in crystalline aluminum at room temperature, but in amorphous aluminum it is almost normal. The concentration of the conduction electrons and the effective collision frequency of the electrons, which determine the refractive index, are calculated, and it is shown that on going from crystalline to amorphous layers, the conduction electron concentration increases from approximately

Card 1/2

L 15673-66

ACC NR: AP6000196

one electron per atom to three electrons per atom. The effective frequency of electron collision also increases noticeably on going from the crystalline to the amorphous state. This strong influence of the periodic structure on the atomic properties of polyvalent metals can be attributed to the different role played by the interelectronic interaction in the two forms. Orig. art. has: 2 formulas and 2 tables.

SUB CODE: 20,07,11/ SUBM DATE: 12Jun65/ ORIG REF: 010/ OTH REF: 001

Card 2/2

L 3676-66 EWT(m)/EWP(w)/T/EWP(t)/EWP(b) JD

ACCESSION NR: AP5021885 UR/0020/65/163/006/1352/1355

AUTHORS: Ginzburg, V. L. (Corresponding member AN SSSR); Motulevich, G. P.; Pitayevskiy, L. P.

TITLE: Optical properties of polyvalent metals and interelectronic interaction

SOURCE: AN SSSR. Doklady, v. 163, no. 6, 1965, 1352-1355

TOPIC TAGS: Fermi surface, optical electron, valence electron, polyvalent metal, polyvalent metal electron

ABSTRACT: A critical examination of literature data pertaining to the ratio of optical electrons to valence electrons for Au, Ag, Al, Sn, and Pb is presented. The data are examined in terms of the Fermi surface integral

$$\oint v\,dS \simeq \frac{4\pi p_F^2}{m} \simeq \frac{3\,(2\pi\hbar)^3}{2m} N_{val},$$

where m and p_F are the mass and momentum on the Fermi surface of the free electron and N_{val} the number of valence electrons per cm^3. It is concluded that the observed decrease of N optical from N valence in Al, Sn, and Pb is most probably due to interelectronic interactions. However, two difficulties regarding the

Card 1/2

L 3676-66

ACCESSION NR: AP5021885

above explanation are noted. For all polyvalent metals, the number of optical electrons per atom n opt $\simeq$1, a fact the authors are unable to explain. The assumption that interelectron interaction exerts a strong influence on the ratio n_{opt}/n_{val} is not supported by any existing theoretical model. The authors thank M. Ya. Asbel' and D. Payns for their helpful criticism. Orig. art. has: 2 tables and 7 equations.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva, Akademii nauk SSSR (Physical Institute, Academy of Sciences, SSSR); Institut fizicheskikh problem, Akademii nauk SSSR (Institute for Physical Problems, Academy of Sciences, SSSR)

SUBMITTED: 04Jun65 ENCL: 00 SUB CODE: MM, OP

NO REF SOV: 013 OTHER: 004

Card 2/2

ACC NR: AP6036059 SOURCE CODE: UR/0056/66/051/004/1220/1226

AUTHOR: Gurzhi, R. N.; Motulevich, G. P.

ORG: Institute of Physics im. P. N. Lebedev, AN SSSR (Fizicheskiy institut AN SSSR); Physicotechnical Institute, AN UkrSSR (Fiziko-tekhnicheskiy institut, AN UkrSSR)

TITLE: Effect of a periodic lattice potential on the optical properties and other integral characteristics of cubic polyvalent metals

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 51, no. 4, 1966, 1220-1226

TOPIC TAGS: metal property, optic property, optic method, cubic polyvalent metal, Fermi surface, periodic lattice potential

ABSTRACT: Analytic expressions are obtained which make it possible to estimate the effect of a periodic lattice potential on the conductivity electron concentration as determined by optical methods, N_{opt}, as well as on the magnitude of the Fermi surface S_F and electron state density on the Fermi surface γ_F. The expressions pertain to cubic nontransition polyvalent metals. The calculation is performed to

Card 1/2

ACC NR: AP6036059

first order terms with respect $|V_g|/E_F$, where V_g is the Fourier component of the pseudopotential and E_F is the electron energy on the Fermi surface. The formulas are employed for determining N_{opt} for lead and aluminum. The effect considered leads to a much smaller value of N_{opt} than that of N_{val} (N_{val} is the valency electron concentration). However, it does not completely explain the difference $N_{val} - N_{opt}$ observed experimentally. The authors express their gratitude to V. L. Ginzburg, L. V. Keldysh and L. P. Pitayevskiy for discussions of problems pertaining to this work. Orig. art. has: 19 formulas and 1 figure. [Authors' abstract] [AM]

SUB CODE: 20, 11/SUBM DATE: 04May66/ORIG REF: 008/OTH REF: 003/

Card 2/2

ACC NR: AP7003202 SOURCE CODE: UR/0056/66/051/006/1622/1633

AUTHOR: Golovashkin, A. I.; Levchenko, I. S.; Motulevich, G. P.; Shubin, A. A.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences, SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Optical properties of indium

SOURCE: Zh eksper i teor fiz, v. 51, no. 6, 1966, 1622-1633

TOPIC TAGS: indium, optic property, conduction electron, electron density, electron collision

ABSTRACT: This is a continuation of earlier investigations of the optical properties of polyvalent metals carried out at the Optical Laboratory of the Physics Institute im. P. N. Lebedev (ZhETF v. 51, 1220, 1966, and earlier). The present paper deals with the optical properties of indium in the range from 0.55 to 10 μ, made at temperatures 4.2 and 295K. A new technique for preparing indium films whose properties do not differ greatly from those of bulk indium is described. The experimental apparatus was described in earlier papers. The measurements at room temperature, which were carried out in two different experimental setups, agreed within 0.5%. The measurements at helium temperature were performed with the apparatus described earlier (ZhETF v. 47, 64, 1964). The following microscopic properties of the conduction electrons were determined: conduction electron density, electron collision frequency, mean electron velocity on the Fermi surface, and total area of the Fermi surface.

ACC NR: AP7003202

The following characteristics of the interband transitions were determined: Fourier coefficients of the pseudopotential, threshold frequencies of the interband transitions, and the frequency dependence of the absorption near threshold. Relationships between these two groups of properties are established and the temperature dependences of the properties are determined. The agreement between the electron-structure parameters obtained by different methods indicates that these relationships agree well with reality. Orig. art. has: 6 figures, 12 formulas, and 4 tables.

SUB CODE: 20/ SUBM DATE: 23Jun66/ ORIG REF: 014/ OTH REF: 006

MOTULEVICH, Pavel Antonovich.

Bukhgalterskiy Uchet Na ZheleznodoRozhnom Transporte (Accounting in Railroad Transport, by) P. A. Moteluvich, P. S. Ushakov (1) I. M. Shukhatovich. Moskva, Transheldorizdat, 1956.

359 p.

L 02246-67 EWT(1)/EWT(m)/EWP(w)/T/EWP(t)/ETI IJP(c) JD

ACC NR: AR6013681 SOURCE CODE: UR/0058/65/000/010/E110/E110

AUTHOR: Golovashkin, A. I.; Motulevich, G. P.

TITLE: Optical and electric properties of tin

SOURCE: Ref. zh. Fizika, Abs. 10E890

REF SOURCE: Tr. Komis. po spektroskopii. AN SSSR, vyp. 1, 1964, 437-447

TOPIC TAGS: tin, superconductivity, electric conductivity, critical point, Hall effect, skin effect, conduction electron, electron collision, temperature dependence, Debye temperature

ABSTRACT: The authors measured the optical constants of Sn in the spectral region 0.7-12 μ at room temperature and at 77°. For the same samples, they measured the static conductivity at room temperature and at nitrogen, hydrogen, and helium temperatures, the density, the critical temperature of transition to the superconducting state, and the Hall effect. The reduction of the data was made with allowance for the character of the skin effect. The results yielded the concentration of the conduction electrons, the velocity on the Fermi surface, and the frequencies of the electron collisions. From the dependence of the conductivity on the temperature the authors determined the Debye temperature of the investigated samples. [Translation of abstract]

SUB CODE: 20

Card 1/1

MOTULEVICH, V.P., kand.tekhn.nauk

Calculating the rate of drying of a plate inswept by a gas flow and associated with the formation of a laminar boundary layer. Nauch.trudy MLTI no.9:79-88 '58. (MIRA 11:12)
(Drying) (Boundary layer)

MOTULEVICH, V.P., kand.tekhn.nauk

Frontal heat exchange. Nauch.trudy MLTI no.9:89-100 '58.
(MIRA 11:12)
(Heat--Transmission)

MOTULEVICH, V.P.

Calculating the heat exchange and the rate of destruction of bodies having extraneous substances on their surfaces in a gas flow without longitudinal pressure gradients. Inzh.-fiz.zhur. no.10:38-46 O '58. (MIRA 11:11)

1. Energeticheskiy institut AN SSSR, g. Moskva.
(Fluid dynamics) (Heat--Transmission)

S/124/60/000/005/003/007
A005/A001

Translation from: Referativnyy zhurnal, Mekhanika, 1960, No. 5, p. 46, # 5819

AUTHOR: Motulevich, V.P.

TITLE: The Flow of a Gas out of a Flat Obliquely Cut-Off Nozzle

PERIODICAL: V sb.: Fiz. gazodinamika, Moscow, AN SSSR, 1959, pp. 94-114

TEXT: Some experiments are described, which permit the interpretation of qualitative properties of the gas flow out of an obliquely cut off cascade. An approximate solution is presented, under certain assumptions, for the potential flow of an ideal gas out of a flat cascade, cut-off obliquely and consisting of rectilinear sheets of infinitely small thickness, for critical, supercritical, and subcritical expansion ratios. The correlations of the deviation angle of flow in the flat obliquely cut-off nozzle are given for isentropic expansion and for the flow passing through a closing compression jump in cases of critical and supercritical expansion. In case of subcritical expansion, the special case (case of the ideal Laval nozzle) of flow is considered, when the perturbations are not reflected

Card 1/2

B

S/124/60/000/005/003/007
A005/A001

The Flow of a Gas out of a Flat Obliquely Cut-Off Nozzle

from the interface. The calculation procedure for the flow in the obliquely cut section of the nozzle is described. There are 11 references.

V.N. Gusev

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

S/124/60/000/006/011/039
A005/A001

26.2120
Translation from: Referativnyy zhurnal, Mekhanika, 1960, No. 6, p. 61, # 7229

AUTHOR: Motulevich, V.P.

TITLE: The Asymmetrical Flow of a Hypersonic Gas Stream Around Edges of Finite Thickness

PERIODICAL: V sb.: Fiz. gasodinamika. Moscow, AN SSSR, 1959, pp. 115-134

TEXT: Experimental results of investigations of a hypersonic stream behind a plate are presented in application to the problem of the flow around the exit edges of turbine cascades, and it is attempted to apply to this flow the method worked out by Crocco and Lees (Crocco, L, Lees, L, J.Aeronaut. Sci., 1952, Vol. 19, No. 10, p. 649 - RzhMekh, 1954, No. 11, 5652). Reviewer's note: The author does not cite the works, known to him, on the problem considered: M.Ye.Deych, 1948 (Tekhnicheskaya gazodinamika. Gosenergoizdat, 1953), and the reviewer's work performed in 1951 (Gidrodinamicheskiye metody rascheta ustanovivshegosya obtekaniya reshetok turbomashin. Diss. In-t mekhan. AN SSSR. Moscow, 1957).

G.Yu. Stepanov

Translator's note: This is the full translation of the original Russian abstract.

Card 1/1

10(2) PHASE I BOOK EXPLOITATION SOV/2162

Akademiya nauk SSSR. Energeticheskiy institut.

Fizicheskaya gazodinamika (Physical Gas Dynamics) Moscow, 1959. 167 p. 3,000 copies printed.

Resp. Ed.: A.S. Predvoditelev, Corresponding Member, USSR Academy of Sciences; Ed. of Publishing House: R.I. Kosykh; Tech. Ed.: Ye. V. Makuni.

PURPOSE: This collection of articles is intended for scientific workers, instructors, engineers, and advanced vuz students specializing in the field of gas dynamics and the physics of combustion.

COVERAGE: This collection of articles is concerned with the results of work performed at the Power Institute, Academy of Sciences, USSR, during the years 1952-1955. Problems of gas dynamics and thermodynamic properties of air at high temperatures (up to 12,000° K) in a wide range of pressures from 0.001 to 1,000 atm. are discussed. Methods are presented for calculating a normal shock with

Card 1/11

SOV/2162

Physical Gas Dynamics

also given.

Motulevich, V.P. Flow of Gas from an Obliquely Truncated Nozzle 94
This paper is concerned with the flow phenomena at the exit of an obliquely cut nozzle containing a plane-parallel grid of blades. The author investigates the parameters of flow ahead of turbine blades, the magnitude of the losses occurring in flow from the nozzle and methods of reducing them. The investigation starts with a visual study of flow in a universal nozzle fastened to the diffuser of the entrance duct of an altitude chamber. The apparatus permitted an investigation of truncation angles between 90 and 19°. On the basis of these experiments a physical theory is presented for three conditions, namely the cases of critical expansion, overexpansion, and underexpansion. An analytical method based on the equations of gas dynamics is developed for calculating the flow in a truncated nozzle.

Motulevich, V.P. Unsymmetrical Supersonic Gas Flow About Edges of Finite Thickness 115
The first part of the paper is concerned with an experimental study of supersonic flow about edges of finite thickness. The

Card 6/11

tests were made with a universal nozzle and a series of blades having identical plan forms but differing in thickness, edge shape, and material. Photographs of the flow as well as pressure measurements were obtained. The results of these tests permit a qualitative description of the flow pattern and the mechanism leading to the formation of compression shocks. The qualitative and quantitative observations provide additional information on base vacuum associated with the expansion of gas under conditions of unsymmetrical flow. The effects of the following parameters on the flow about blunt edges and on the magnitude of the base pressure are determined: stagnation pressure, thickness and shape of blade edges, and position in a blade cascade. An approximate physical and empirical analysis is presented for both symmetrical and unsymmetrical flow about edges of finite thickness as in the case of expansion of a gas in the oblique section of a turbine nozzle. Good agreement between the calculations and experimental data is indicated. The author states that additional theoretical and experimental work is required for a more rigorous theoretical

AUTHOR: Motulevich, V.P. (Moscow) SOV/24-59-1-5/35

TITLE: Calculation on Heat Transfer and Friction of a Flat Plate in Supersonic Flow in the Presence of Pore Gas and Sublimation in the Laminar Boundary Layer (Raschet teploobmena i treniya ploskoy plastiny, obduvayemoy sverkhzvukovym potokom, pri nalichii poristogo podvoda gaza i sublimatsii v usloviyakh laminarnogo pogranichnogo sloya)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, Energetika i Avtomatika, 1959, Nr 1, pp 33-38 (USSR)

ABSTRACT: The author describes a method of calculation of the laminar boundary layer with a supply of gas when no other factors are considered. A flat plate in the supersonic flow is placed perpendicularly to the surface supplying the gas. The distribution of forces of friction and the heat transfer on the surface of the plate is determined with an assumption that its temperature is constant and the gas parameters are known. The thickness of the thermal (Δ) or dynamic (δ) layers is variable. The figure on p 33 represents the coordinates where

Card 1/4

SOV/24-59-1-5/35

Calculation on Heat Transfer and Friction of a Flat Plate in Supersonic Flow in the Presence of Pore Gas and Sublimation in the Laminar Boundary Layer

$\Delta \geqslant \delta$. The following 3 equations are defined for an element of the boundary layer: the equation of continuity (1.1) (G - heat consumption in the thermal layer, dG_{∞}, dG_W - increase of the consumption due to the stable flow and the gas supply from the porous wall), the equation of motion projected on the axis x, (1.2), (τ_W - tension on the wall due to friction, L - the motion in the layer), the equation of energy (1.3) (E - flow of energy in the layer, H - frictional action, q_W - flow of heat in the wall). The velocity of supersonic flow is defined by the Eq (1.4) where Z - constant parameter. This equation can be solved when Eq (1.5) is introduced. Then Eq (1.2) and (1.3) can be solved in respect of δ which is determined from Eq (1.6) and (1.7) with the values of I_1, I_2, and I_3 determined from Eq (1.16), (1.17) and (1.18). The motion and energy of the boundary layer on the wall can be defined by Eq (1.12) and (1.13). The heat transfer (f_λ) and the viscosity (f_μ) can be considered as the

Card 2/4

SOV/24-59-1-5/35

Calculation on Heat Transfer and Friction of a Flat Plate in Supersonic Flow in the Presence of Pore Gas and Sublimation in the Laminar Boundary Layer

kinetic parameters (1.14). The characteristic parameters of the heat flow ($\bar{q}_W$) in the walls, friction ($\bar{\tau}_W$) and intensity of supersonic flow ($\bar{z}$) can be expressed by Eq (1.23) to (1.26). Thus the problem will be solved when the relation of the friction and the heat flow in the walls to the intensity of the stream will be determined in the parametric form (1.26) (m - parameter). The calculation can be best performed if: 1) the values of m and B (Eq 2.1) are determined together with $\bar{\Delta}$, b, I_1, I_2, I_3, found from Eq (1.21), (1.19) (1.16) (1.17) and (1.18), 2) the true value of B is found together with I_2, I_3, b and $\bar{q}_W$, $\bar{\tau}_W$ and $\bar{z}$ are determined from Eq (1.26). The condition $\bar{\Delta} \gg 1$ should be always applied. In the case of the plate with the sublimating surface, the assumption is made that the plate remains flat and the intensity of evaporation is small. The equation of evaporation can be expressed as Eq (3.1) where $q_W \sim \tau_W$ and the value of $\bar{z}$ is found from

Card 3/4

SOV/24-59-1-5/35

Calculation on Heat Transfer and Friction of a Flat Plate in Supersonic Flow in the Presence of Pore Gas and Sublimation in the Laminar Boundary Layer

Eq (3.2). The rate of evaporation can be found from Eq (1.26) and (3.2) with an application of the relationship $\bar{q}_w = f(z)$. The energy required for the cooling can be found from Eq (4.1) where $(i_w - i_{init})$ - rate of cooling. The intensity of cooling can be determined from Eq (4.2). The above equation can also be applied to other forms of body affected by the supersonic flow when a suitable correction is made. Thus, the relations (5.1) and (5.2) can be applied to the cylinder and the cone, respectively. There is 1 figure and 6 references of which 4 are Soviet and 2 English.

SUBMITTED: 13th September 1958

Card 4/4

31288
S/124/61/000/010/022/056
D251/D301

10 3400
26.2181

AUTHOR: Motulevich, V. P.

TITLE: Heat exchange at a frontal point of types of bodies washed by a supersonic stream of gas

PERIODICAL: Referativnyy zhurnal. Mekhanika, no. 10, 1961, 75, abstract 10 B539 (V sb. Konvektivn. i luchistyy teploobmen. M., AN SSSR, 1960, 16-24)

TEXT: In considering the flow of a supersonic stream of gas around some body having planar or axial symmetry, the author proposes determining the heat exchange at a frontal point, not by the position of the boundary layer as is generally done, but from the analysis of the processes in the central stream of the current striking the body. A simple approximation method is developed for calculating the thermal flow, whose basic conditions were advanced earlier by the author in application to the flow of an incompressible fluid. It is assumed that the heat-exchange process is deve-

X

Card 1/3

31288
S/124/61/000/010/022/056
D251/D301

Heat exchange...

loped in a narrow bounded zone of the central stream of the current, where the temperature changes from the temperature of adiabatic drag to the temperature of the walls, and the pressure is, for practical purposes, constant and equal to the pressure of the retarded flow. (This assumption is based on a preliminary investigation and certain experimental data). The effect of dispersion in the neighborhood of the frontal point is ignored, and the physical parameters of the gas are assumed constant. For a suitable selection of the latter, a satisfactory concordance is reached with the experiment in the breadth of the range of parameters of the incident current. For the heat of the current the author obtains the following relationship:

$$N = \frac{1}{\int_{-\infty}^{0} e^{P\int_0^{\bar{x}} \bar{u}dx} dx} \qquad \left(N = \frac{q_w r}{(T_0 - T_w)\lambda},\quad P = \frac{u_* r}{x}\right)$$

X

Card 2/3

31288

Motulevich, V.P.

PHASE I BOOK EXPLOITATION SOV/4396

Akademiya nauk SSSR. Energeticheskiy institut

Konvektivnyy i luchistyy teploobmen (Convection and Radiation Heat Exchange) Moscow, Izd-vo AN SSSR, 1960. 254 p. Errata slip inserted. 3,200 copies printed.

Ed.: M.A. Mikheyev, Academician; Ed. of Publishing House: G.B. Gorshkov; Tech. Ed.: V.V. Bruzgul'.

PURPOSE: The book is intended for scientists and engineers working in various branches of science and industry concerned with thermodynamics and heat transfer problems.

COVERAGE: The book consists of 19 original articles on various problems in thermodynamics. The following subjects are discussed: mechanism of heat transfer processes, intensification of heat exchange, determination of thermophysical properties of operating media, heat transfer in supersonic flow of gas, and combustion chambers and nuclear reactors. Theory and experimental techniques are described. Each article describes the conditions of the experiment and tables of the experimental data obtained are given. The data may be used for calculations of heat transfer and heat exchangers, always taking account of

Card 1/ 5

the special experimental conditions under which the data were established. No personalities are mentioned. References follow most of the articles.

TABLE OF CONTENTS:

SOV/4396

Card 4/5

S/170/60/003/005/003/017
B012/B056

AUTHOR: Motulevich, V. P.

TITLE: Heat Exchange on the Front Point of an Obtuse Body Round Which a Liquid Stream Flows

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, 1960, Vol. 3, No. 5, pp. 17 - 23

TEXT: Reference is first made to the theoretical investigations of heat exchange on the front point of a body round which a liquid stream flows (Skvayr (Ref. 1), D. Sibulkin (Ref. 2), and J. Fay and F. J. Ridell (Ref. 3)). In these papers, the problem is solved after proceeding from the theory of the boundary layer. Here, a method of investigating the heat exchange at the front point is given by proceeding from different view points: The processes in the central thread of flow are investigated. The plane or axially symmetric body round which an incompressible liquid flows, and which is shown in Fig. 1, is investigated. It is shown that in the neighborhood of the central thread of flow, including the front point, the problems of heat exchange may be

Card 1/3

Heat Exchange on the Front Point of an Obtuse Body Round Which a Liquid Stream Flows

S/170/60/003/005/003/017
B012/B056

solved in a manner similar to that in the problem of Bussinesk. The energy equation in this case takes the same form as that of a non-viscous liquid: formula (2). Formula (9) for Nu = f(Pe) is derived. For the cases of a continuous potential flow round various bodies, formula (10) is written down for determining the quantity contained in formula (9). It is shown that the intensity of heat exchange should be somewhat lower than that obtained from formula (9), but that this may be neglected in first approximation. On the basis of a comparison with the exact solution and the experiment, such a neglect is shown to be justified. Fig. 2 shows the functions Nu = f(Pe), constructed according to formula (9) for the various bodies. As a direct use of formula (9) involves numerical integration, an approximate formula (20) for determining the Nu-number is derived, which holds for any plane and axially symmetric bodies. The theoretical and experimental data concerning the heat exchange at the front point of a circular cylinder are compared in Fig. 3. The agreement among the experimental data and with the results obtained by calculation according to the method described here is considered to be satisfactory. Finally, the formulas for Nu = f(Pe) are written down with the help of formula (20) for the case of a continuous potential flow round

Card 2/3

Heat Exchange on the Front Point of an Obtuse Body Round Which a Liquid Stream Flows

S/170/60/003/005/003/017
B012/B056

various bodies. Fig. 3 shows experimental data obtained by G. N. Kruzhilin (Ref. 8), G. N. Kruzhilin and I. G. Shvab (Ref. 4), V. A. Zhukovskiy (Ref. 5), Shmidt and Venner (Ref. 1). There are 3 figures and 9 references: 5 Soviet and 1 British.

ASSOCIATION: Energeticheskiy institut im. G. M. Krzhizhanovskogo, g. Moskva (Institute of Power Engineering imeni G. M. Krzhizhanovskiy, Moscow)

Card 3/3

Motulevich, V. P.

S/170/60/003/008/003/014
B019/B054

AUTHOR: Motulevich, V. P.

TITLE: Heat Exchange and Friction of a Plate in a Gas Flow in the Formation of a Turbulent Boundary Layer With a Feed of Foreign Substance Through Pores

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, 1960, Vol. 3, No. 8, pp. 31-38

TEXT: In the introduction, the author mentions some papers dealing with this subject. He describes a method of calculating friction and heat exchange of a plane porous plate in the flow of a compressible gas while a substance different from the gas is being supplied through the pores. In the first part, the author discusses the setting up of the problem, and indicates the initial assumptions. It is shown that the feeding of a foreign gas influences both the heat exchange coefficient and the friction coefficient. For an exact solution of the problem, the author makes, in the second part, an analysis of the dynamic characteristics of the boundary layer. He investigates the friction

Card 1/2

Heat Exchange and Friction of a Plate in a Gas Flow in the Formation of a Turbulent Boundary Layer With a Feed of Foreign Substance Through Pores

S/170/60/003/008/003/014
B019/B054

coefficient on the surface as a function of the plate length, and deals with the determination of the thickness of the boundary layer. In the final part, he deals with the determination of the surface concentration of the substance added, and obtains equation (34). Further, he makes comparisons with experimental results. Fig. 1 graphically shows the heat exchange coefficient as a function of the supply of helium and nitrogen. Finally, the author discusses further possibilities of applying the method described. He thanks A. I. Leont'yev for permitting the publication of results obtained from his calculations. There are 1 figure and 7 references, 4 of which are Soviet.

VB

ASSOCIATION: Energeticheskiy institut im. G. M. Krzhizhanovskogo, g. Moskva (Institute of Power Engineering imeni G. M. Krzhizhanovskiy, Moscow)

SUBMITTED: March 15, 1960

Card 2/2

MOTULEVICH, V. P., PETROV, Y. N., and YEROSHENKO, V. M.

"The Effect of Electrical Fields on Heat Transfer By Convection."

Report submitted for the Conference on Heat and Mass Transfer, Minsk, BSSR, June 1961.

26.4110

S/124/62/000/006/014/023
D234/D308

AUTHORS: Yeroshenko, V. M., Korozov, M. G., Motulevich, V. P., Petrov Yu. N. and Pushkin, V. S.

TITLE: A gas dynamic installation with an ИТ-14 (IT-14) interferometer

PERIODICAL: Referativnyy zhurnal, Mekhanika, no. 6, 1962, 44-45, abstract 6B283 (V. sb. Fiz. gazodinamika i teploobmen. M., AN SSSR, 1961, 51-59)

TEXT: A short description of a wind tunnel constructed at the laboratory of combustion physics. The tunnel is fed either from an air bottle battery with a capacity of 17.6 m^3 at a pressure of 200 kg/cm^2, or the air is sucked into the tunnel from the atmosphere. The working part of the installation is placed in an Eiffel chamber in which a rarefaction up to 5 - 10 mm Hg is produced by a vacuum installation consisting of five pre-vacuum pumps of РМК-4 (RMK-4) type and 12 vacuum pumps of ВН-6 (VN-6) and ВН-6Г (VN-6G) types. The tunnel is provided with an electric heater se-

Card 1/2

S/124/62/000/006/024/027
D234/D308

A gas dynamic ...

curing an air temperature up to 400°C. A set of exchangeable plane profiled nozzles makes it possible to change the Mach's number from infrasonic values to M = 3.1 during vacuum work. The dimension of the working part is 30 - 40 mm (exact dimensions are not given in the paper). The are optical viewing glasses in the side walls of the nozzle and in the cylindrical Eiffel chamber 1200 mm in diameter. The tunnel is provided with a coordinate device and with apparatus for measuring and recording the pressures and temperatures (thermocouples, manometers, vacuum meter, automatic recorders, oscillographs). Optical observation of flow can be made with the aid of the interference-shadow device IT-14 which is a combination of a Mach-Zender type interferometer with Tepler's device. Special measures are taken for isolating the optical device from vibrations (an isolated support with damping rubber cushions). The IT-14 device is provided with photographic accessories and illuminating devices of various types, among them a spark installation with an exposure less than 10^{-6} sec. The paper is illustrated by interferograms. [Abstracter's note: Complete translation.]

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D234/D308

26 5200

AUTHORS: Motulevich, V.P., Yeroshenko, V.M. and Petrov, Yu.N.

TITLE: Effect of electrostatic fields on convective heat exchange

PERIODICAL: Referativnyy zhurnal, Mekhanika, no. 1, 1963, 72, abstract 1B446 (In collection: Fiz. gazodinamika i teploobmen. M., AN SSSR, 1961, 94-103)

TEXT: The authors carried out theoretical and experimental investigations into the effect of a strong electrostatic field on the heat exchange of a body surrounded by a gas. The model under investigation was a thin copper wire 0.04 mm in diameter, 79 mm long with zero potential (which was also heated) combined with a 60 x 60 mm copper plate, or a 60 mm long brass cylinder, with inner diameter 44 mm, which were connected to a voltage up to 50 kV. The wire was connected into a bridge circuit which supplied it with current and heated it, and determined its temperature by measuring its resistance. The temperature of the wire was fixed and equal to 188°C. When an

Card 1/2

S/124/63/000/001/025/080
D234/D308

Effect of electrostatic ...

electric field was applied to the flat model the heat exchange varied little, but when a voltage exceeding 10kV was applied to the brass cylinder, the heat exchange increased rather rapidly according to a linear law and when the voltage was 25 kV the heat flow from the wire increased by more than 15%. For a voltage of 20 - 25 kV the interference pattern in the cylinder model changed sharply. On the basis of a qualitative analysis of the so-called electric convection observed under these circumstances, a dimensionless parameter was obtained which describes the quantitative aspect of these phenomena.
[Abstracter's note: Complete translation]

Card 2/2

S/124/62/000/007/014/027
D234/D308

24.5200

AUTHORS: Motulevich, V. P. and Malyshev, G. P.

TITLE: Effect of dissociation on heat exchange and friction of a plate in an air stream

PERIODICAL: Referativnyy zhurnal, Mekhanika, no. 7, 1962, 73, abstract 7B494 (V sb. Fiz. gazodinamika i teploobmen. M., AN SSSR, 1961, 104-114)

TEXT: The authors consider a plate in a stream of dissociating gas forming a laminar boundary layer. At sufficiently high velocities of the stream, viscous dissipation of energy can lead to a considerable increase of temperature of the boundary layer, so that gas dissociation can begin within the layer even when the temperature in the undisturbed stream is comparatively low. Two extremum cases are considered: a) When the time of reaction τ_r is much larger than the time of passing of the stream near the wall τ_n, b)

Card 1/2

Effect of dissociation ... S/124/62/000/007/014/027
D234/D308

$T_r \leq T_n$. The equations of conservation of substance, momentum and energy for the case of a boundary layer on a plane plate have the same form for both cases. In the case of high velocities of chemical reactions, effective values of physical parameters are used in the equations. The system was solved by numerical methods. The results showed that the dissociation process does not essentially affect the friction of the plate. As long as the temperature does not reach the values at which the air begins to dissociate, the dissociation process has a weak effect on the heat exchange. At a high temperature of the wall, the thermal flow towards it in presence of dissociation is smaller than in case a). The equilibrium temperature of the wall also decreases. Maximum temperature in the boundary layer in the case of dissociation is less than in case a), and there can be essential difference also when the effect of dissociation on the heat flow is still insignificant. The higher the velocity of the incident stream, the stronger is the effect of dissociation. [Abstracter's note: Complete translation.]

Card 2/2

MOTULEVICH, V P

9

PHASE I BOOK EXPLOITATION SOV/5698

Akademiya nauk SSSR. Energeticheskiy institut.

Fizicheskaya gazodinamika i teploobmen (Physical Gas Dynamics and Heat Exchange) Moscow, 1961. 112 p. Errata slip inserted. 4,000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Energeticheskiy institut im. G. M. Krzhizhanovskogo.

Resp. Ed.: A. S. Predvoditelev, Corresponding Member, Academy of Sciences USSR; Ed. of Publishing House: S. L. Orpik; Tech. Ed.: S. P. Golub'.

PURPOSE : This book is intended for engineers and scientific workers interested in supersonic flow of gases, aerodynamic heat phenomena, and the dissociation of gases.

COVERAGE: This collection consists of 15 papers written at the Laboratoriya fiziki goreniya Energeticheskogo instituta Akademii

Card 1/5

9

nauk SSSR (Laboratory of Combustion Physics of the Power Institute of the Academy of Science USSR) on investigations on the physics of gas dynamics and phenomena of heat exchange in supersonic flows. In the field of physical gas dynamics motions of the medium with possible transformations of the substance, not excluding such processes as the thermal ionization of molecules and atoms, are discussed. No personalities are mentioned. References follow most of the articles.

TABLE OF CONTENTS:

APPROVED FOR RELEASE: 07/12/2001 CIA-RDP86-00513R001135420006-9"

Physical Gas Dynamics and (Cont.) SOV/5698

Card 4/5

9

Physical Gas Dynamics and (Cont.) SOV/5698

With Local Supply of Refrigerant in a Longitudinal Supersonic Flow 89

Motulevich, V. P., V. M. Yeroshenko, and Yu. N. Petrov. Effect of Electrostatic Fields on Convective Heat Transfer 94

Motulevich, V. P., and G. P. Malyshev. Effect of Dissociation on Heat Exchange and Friction in a Plate in a Flow of Air 104

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Card 5/5

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27553

S/170/61/004/010/007/019
B109/B138

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AUTHOR: Motulevich, V. P.

TITLE: Complete system of equations of a laminar boundary layer and boundary conditions for the case where there are sources of substance and energy in a gas flow and on the surface of a solid

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, v. 4, no. 10, 1961, 44 - 51

TEXT: Fundamental fluid-dynamic equations are obtained, which take into account chemical and phase transformations taking place in a gas flow and on the surface of a solid, which is in this flow and is of plane or axisymmetric shape, and through the surface pores of which an arbitrary gas can flow. The X-axis is assumed to run along the contour of the body. k denotes the proportion by weight of one component, m the molecular weight, D_{ij} the diffusion coefficient, D_i^T the thermal diffusion coefficient, R the gas constant, w the sources attributable to chemical processes, r_o the radius of the solid of revolution, $\alpha = 0$ for plane and $\alpha = 1$ for
Card 1/9

axisymmetrical bodies, h the enthalpy, and D the diffusion coefficient of a two-component mixture. For such a system the diffusion equation reads

$$\varrho\left(\frac{\partial k_i}{\partial t} + u\frac{\partial k_i}{\partial x} + v\frac{\partial k_i}{\partial y}\right) = -\left\{\frac{\partial}{\partial y}\left(\frac{\varrho m_i}{m^2}\sum_j\left[D_{ij}\frac{\partial}{\partial y}(k_j m)\right]\right)\right\} -$$

$$-\left\{\frac{\partial}{\partial x}\left\{\frac{\varrho m_i}{m^2}\sum_j\left[D_{ij}k_j(m - m_j)\frac{\partial}{\partial x}\ln p\right]\right\}\right\} +$$

$$+\frac{\partial}{\partial y}\left(\frac{\varrho m_i}{m^2}\sum_j\left[D_{ij}k_j(m - m_j)\frac{\partial}{\partial y}\ln p\right]\right) + \qquad (1),$$

$$+\left\{\frac{\partial}{\partial x}\left\{\frac{\varrho m_i}{m^2}\sum_j\left\{D_{ij}\frac{k_j m_j m}{RT}\left[X_j - \sum_k(k_k X_k)\right]\right\}\right\}\right\} +$$

$$+\frac{\partial}{\partial y}\left\{\frac{\varrho m_i}{m^2}\sum_j\left\{D_{ij}\frac{k_j m_j m}{RT}\left[Y_j - \sum_k(k_k Y_k)\right]\right\}\right\} +$$

$$+\frac{\partial}{\partial y}\left[D_i^T\left(\frac{\partial}{\partial y}\ln T\right)\right] + w_i,$$

Complete system of equations of a...

the continuity equation

$$\frac{\partial \rho}{\partial t} + \frac{\partial}{\partial x}(\rho u r_o^{\alpha}) + \frac{\partial}{\partial y}(\rho v r_o^{\alpha}) = 0 \qquad (2),$$

the momentum equation

$$\rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y}\right) = -\frac{\partial p}{\partial x} + \frac{\partial}{\partial y}\left(\mu\frac{\partial u}{\partial y}\right) + \rho\sum_i (k_i X_i) \qquad (3),$$

the energy equation

27553
S/170/61/004/010/007/019
B109/B138

Complete system of equations of a...

$$\rho\left(\frac{\partial h}{\partial t}+u\frac{\partial h}{\partial x}+v\frac{\partial h}{\partial y}\right)=\frac{\partial}{\partial y}\left(\lambda\frac{\partial T}{\partial y}\right)+$$
$$+\left\{-\sum_{i,l}\frac{\partial}{\partial y}\left[\frac{\rho m_l}{m^2}D_{il}h_i\frac{\partial}{\partial y}(k_l m)\right]-\right.$$
$$-\sum_{i,l}\left\{\frac{\partial}{\partial x}\left[\frac{m_i(m-m_l)}{m^2}k_l\rho D_{il}h_i\frac{\partial}{\partial x}\ln p\right]+\right.$$
$$+\frac{\partial}{\partial y}\left[\frac{m_i(m-m_l)}{m^2}k_l\rho D_{il}h_i\frac{\partial}{\partial y}\ln p\right]\Bigg\}+ \quad (4)$$
$$+\sum_{i,l}\left\{\frac{\partial}{\partial x}\left\{\frac{m_i m_l}{m}k_l\rho D_{il}\frac{h_i}{RT}\left[X_l-\sum_k(k_k X_k)\right]\right\}+\right.$$
$$+\frac{\partial}{\partial y}\left\{\frac{m_i m_l}{m}k_l\rho D_{il}\frac{h_i}{RT}\left[Y_l-\sum_k(k_k Y_k)\right]\right\}\Bigg\}+$$
$$+\sum_i\frac{\partial}{\partial y}\left(h_i D_i^T\frac{\partial}{\partial y}\ln T\right)\Bigg\}-\left\{\sum_{i,l,k}\left\{\frac{\partial}{\partial x}\frac{k_l}{m_i m_l m}RT\frac{D_i^T}{\dot{D}_{il}}\times\right.\right.$$

Card 4/9

27553
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B109/B138

Complete system of equations of a...

4

$$\times\left(D_{ik}\frac{m_i}{k_i}-D_{lk}\frac{m_l}{k_l}\right)\left[k_k(m-m_k)\frac{\partial}{\partial x}\ln p-\right.$$
$$\left.\left.-\frac{k_k m_k m}{RT}\left(X_k-\sum_l k_l X_l\right)\right]+\frac{\partial}{\partial y}\left\{\frac{k_l}{m_i m_l m}RT\frac{D_i^T}{D_{il}}\times\right.$$
$$\times\left(D_{ik}\frac{m_i}{k_i}-D_{lk}\frac{m_l}{k_l}\right)\left[\frac{\partial}{\partial y}(k_k m)+k_k(m-m_k)\frac{\partial}{\partial y}\ln p-\right.$$
$$\left.\left.\left.-\frac{k_k m_k m}{RT}\left(Y_k-\sum_l k_l Y_l\right)\right]\right\}\right\}+\sum_{i,l}\frac{\partial}{\partial y}\left[\frac{k_l}{m_i m_l}\frac{RT}{\rho}\frac{D_i^T}{D_{il}}\times\right. \qquad (4)$$
$$\left.\times\left(\frac{D_i^T}{k_i}-\frac{D_l^T}{k_l}\right)\frac{\partial}{\partial y}\ln T\right]\Bigg\}+\frac{\partial p}{\partial t}+u\frac{\partial p}{\partial x}+\mu\left(\frac{\partial u}{\partial y}\right)^2+$$
$$+\left\{\frac{\rho}{m^2}\sum_{i,l}m_l D_{il}\left\{X_i\left\{\frac{\partial}{\partial x}(k_l m)+k_l(m-m_l)\frac{\partial}{\partial x}\ln p-\right.\right.\right.$$

Card 5/9

27553
S/170/61/004/010/007/019
B109/B138

Complete system of equations of a...

$$-\frac{k_i m_i m}{RT}\left[X_i-\sum_k (k_k X_k)\right]\Big\} + Y_i\Big\{\frac{\partial}{\partial y}(k_i m) + k_i(m-m_i)\frac{\partial}{\partial y}\ln p - \frac{k_i m_i m}{RT}\left[Y_i - \sum_k (k_k Y_k)\right]\Big\}\Big\} - \sum_i D_i^T\left(X_i\frac{\partial}{\partial x}\ln T + Y_i\frac{\partial}{\partial y}\ln T\right)\Big\}, \quad (4)$$

and the equation of state $p/\varrho = RT/m$. Boundary conditions: On the body surface $u_w = 0$ (the subscript w denotes: in wall direction). The diffusion equation reads

Card 6/9

$$k_{i0}w_0 + k_{ic}w_c + w_{i\,\text{xим}} = k_{iw}w_w + \left\{ \frac{p m_i}{m^2} \left\{ \sum_l \left\{ D_{il} \left\{ \frac{\partial}{\partial y}(k_l m) + k_l(m - m_l)\frac{\partial}{\partial y}\ln p - \frac{k_l m_l m}{RT}\left[Y_l - \sum_k (k_k Y_k) \right] \right\} \right\} \right\} - D_i^T \frac{\partial}{\partial y}\ln T \right\}_w .$$

wher k_{io}, k_{ic}, and k_{iw} denote the proportions by weight of the i-th component of the substance which is penetrating into the body through pores, of the products of sublimation, and of chemical transformations on the surface, respectively. The intensity of the sublimation is given by $w_{ic} = A(\varrho_{i\,sat} - \varrho_{iw})$, where A is a coefficient which is dependent on the sublimation process; ϱ_{sat} denotes the density of the saturated vapors.

27553

Complete system of equations of a... S/170/61/004/010/007/019 B109/B138

The energy balance at the wall is given by

$$(wh)_w - (wh)_0 + q_r + q_{\text{изл}} = \left(\lambda \frac{\partial T}{\partial y}\right)_w - \sum_{i,j} \left\{ \frac{m_i h_i}{m^2} \rho D_{ij} \times \right.$$

$$\times \left\{ \frac{\partial}{\partial y}(k_j m) + k_j (m - m_j) \frac{\partial}{\partial y} \ln p - \frac{k_j m_j m}{RT} \left[Y_j - \right.\right.$$

$$\left.\left.\left. - \sum_k (k_k Y_k) \right]\right\}\right\}_w + \sum_i \left(h_i D_i^T \frac{\partial}{\partial y} \ln T \right)_w -$$

$$- \sum_{i,j,k} \left\{ \frac{RT}{m} \frac{k_i D_i^T}{m_i m_j D_{ij}^{\cdot}} \left(D_{ik} \frac{m_i}{k_i} - D_{jk} \frac{m_j}{k_j} \right) \left[\frac{\partial}{\partial y}(k_k m) + \right.\right.$$

$$\left.\left. + k_k (m - m_k) \frac{\partial}{\partial y} \ln p - \frac{k_k m_k m}{RT} \left(Y_k - \sum_l k_l Y_l \right) \right]\right\}_w +$$

$$+ \sum_{i,j} \left[\frac{RT}{\rho} \frac{k_j D_i^T}{m_i m_j D_{ij}^{\cdot}} \left(\frac{D_i^T}{k_i} - \frac{D_j^T}{k_j} \right) \frac{\partial}{\partial y} \ln T \right]_w , \qquad (12)$$

Card 8/9

27553
S/170/61/004/010/007/019
B109/B138

Complete system of equations of a...

where q_T is the flow of thermal energy inside the solid; $(wh)_w = (w_o + \sum_i w_{ci} + w_{chem}) \sum_i (k_i h_i)_w$; q_{rad} the energy flow which passes over to the surrounding medium in the form of heat radiation from the wall of the solid ($w_{хим} = w_{chem}$; $q_{изл} = q_{rad}$). It can be calculated approximately from the Stefan-Boltzmann law. There are 8 references: 4 Soviet and 4 non-Soviet. The three most recent references to English-language publications read as follows: Fay D., Riddell J. Jas, No. 2, 1958; Rosner D. Jet. prop., No. 7, 1958; Scala S., Vidalc G., Int. Journ. Heat-Mass. Tranf., No. 1, 1960.

ASSOCIATION: Energeticheskiy institut im. G. M. Krzhizhanovskogo g. Moskva (Power Engineering Institute imeni G. M. Krzhizhanovskiy, Moscow)

SUBMITTED: April 1, 1961

Card 9/9

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28904
S/170/61/004/011/002/020
B104/B112

AUTHOR: Motulevich, V. P.

TITLE: Heat and mass exchange in the frontal point of blunted bodies in the presence of a heterogeneous chemical reaction

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, v. 4, no. 11, 1961, 10-18

TEXT: The heat and mass exchange of blunted bodies around which an incompressible multicomponent gas A is flowing, is studied for the case where a heterogeneous reaction of finite rate takes place between A and the material B of the bodies. The reaction product is a gas. The following simplifying assumptions are made: 1) The flow exists in the vicinity of the front of the critical point; 2) laminar flow; 3) the surfaces of the bodies do not change; 4) the thermodynamic and gas-kinetic parameters do not change; 5) allowance is made only for concentration diffusion; 6) the wall is adiabatic; 7) the fouling of the surface of the bodies is small, and the reaction takes place on the surface of the body. Under these conditions, the equations derived by the author in a previous paper (IFZh, no. 10, 1961) are reduced to a system of algebraic

Card 1/3

equations. The solutions of this system can only be found by numerical methods. The system is analyzed for a homogeneous body in the presence of one irreversible reaction. The limits of some parameters, the stability of the solutions, the possible types of solutions, and the conditions of inflammation and quenching are discussed. The influence of flow and body characteristics on the rate of removal of the substance, on the surface temperature and concentration of the original products near the bodies are studied. It is shown that there exists an extremum temperature t_w of the reacting surface. The temperatures of inflammation and quenching increase with increasing blow-off rate, decreasing body dimensions, decreasing density, decreasing kinetic constant, increasing activation energy, decreasing heat module of the reaction, and decreasing content of the initial component in flow. If the reaction is reversible, the mass removal will be smaller, and t_w will increase in endothermic reactions and decrease in exothermic reactions. The temperatures of inflammation and quenching increase. There are 3 figures and 5 references: 4 Soviet and 1 non-Soviet. The reference to the English-language publication reads as follows: Fay G., Riddell F., JAS, no. 2, 1958.

28904
S/170/61/004/011/002/020
B104/B112

Heat and mass exchange in the ...

ASSOCIATION: Energeticheskiy institut im. G. M. Krzhizhanovskogo, g. Moskva (Institute of Power Engineering imeni G. M. Krzhizhanovskiy, Moscow)

SUBMITTED: June 1, 1961

Card 3/3