KOCHEGURA, M.Kh. [Kochehura, M.Kh]; MISHIN, M.V.

At the Kharkov Bearing Plant. Nauka i zhyttia 9 no.12:17-20 D '59. (MIRA 13:4)

1. Nachal'nik byuro tekhnicheskoy informatsii Khar'kovskogo podshipnikovogo zavoda (for Kochegura). 2. Otvetstvennyy sekretar' mnogotirazhnoy gazety "Golog rabotnika" Khar'kovskogo podshipnikovogo zavoda (for Mishin).
(Kharkov--Bearing industry) (Automation)

S/743/62/000/001/004/008

AUTHORS: Kochegura, N.M., Krasnoshchekov, M.M., Markovskiy, Ye.A.

TITLE: On the effect of nuclear radiations on the properties of metallic alloys.

SOURCE: Struktura i svoystva litykh splavov. no.1. Inst. lit. proizv. AN USSR. Kiev, Izd-vo AN UkrSSR, 1962, 67-75.

TEXT: The paper provides a discussion based on a literature survey, primarily of English-language Western publications. It discusses the effects of nuclear neutron radiation on metallic alloys in the sense of the Seitz and Brinkmann theories. The effects of neutron radiation on the hardness, tensile strength, and yield point of various steels, including SAE 1018 and 1095, stainless steel 304 and 316, and ASTM-A212B and -A242 with various grain sizes, are summarized in several extensive tables. Radiation impingement on cast structural steels, especially when in the normalized or annealed state, can substantially increase the strength of such materials, affording them a strength that approaches that of work-hardened steel. It is suggested that investigations be performed to establish the changes in the properties of irradiated cast materials versus the radiation dose and to ascertain the minimal radiation dose that affords the desired effect. It appears advisable also to undertake an investigation of the effect of neutron radiation on the heat

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treatment of cast alloys. There are 1 figure, 4 tables, and 23 references (9 Russian-language Soviet, 13 Russian-language translations of English-language original papers, and 1 English-language original: Harries, D., J. of Iron & Steel Inst., v.194, 1960, 289).

ASSOCIATION: Institut liteynogo proizvodstva, AN USSR (Institute of Casting Production, AS UkrSSR).

KOCHEGURA, N.M., insh.; MAKKOVSKIY, Ye. A., kand.tekhn.nauk

Using radioisotopes for checking the density of foundry molds. Mashinostroenie no. 2:53-54 Mr-Ap '64. (MIRA 17:5)

KOCHERGURA, N.M., inzh.; MARKOVSKIY, Ye.A., kand. tekhn. nauk

Using beta radiation for checking the moisture content in molding sands. Mashinostroenie no.5:38-39 S-O '64 (MIRA 18:2)

L 12155-66 EWT(m)/EPP(n)-2/T/EWA(d)/EWP(t)/EWP(z)/EWP(b)/EWA(h) JD/DJ

ACC NR: AP5028371 SOURCE CODE: UR/0369/65/001/005/0552/0556

AUTHOR: Markovskiy, Ye. A.; Krasnoshchekov, M. M.; Kochegura, N. M.

ORG: Institute of Foundry Problems, AN UkrSSR, Kiev (Institut problem lit'ya AN UKrSSR)

TITLE: Changes in the antifriction and strength characteristics of structural materials subjected to neutron irradiation

SOURCE: Fiziko-khimicheskaya mekhanika materialov, v. 1, no. 5, 1965, 552-556

TOPIC TAGS: steel, copper, antifriction material, antifriction metal, neutron irradiation, nuclear reactor material, cast iron, irradiation effect, fabricated structural metal, metal physical property, stress relaxation

ABSTRACT: This work studies the changes in the antifriction parameters of some structural metals and alloys subjected to various degrees of neutron irradiation in an operational neutron reactor. Simultaneously, the changes in some of the strength characteristics of the materials are also determined. The materials studied were steel No. 45, various types of cast iron, copper, and SB-30 lead bronze. The results obtained give grounds to conclude that the accelerated process of stress relaxation under the effect of irradiation may take place not only for stressed materials but also for metastable hardened structures. An attempt

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L 12165-66

ACC NR: AP5028371

is made to explain the time-dependent decrease in the strength of steel subjected to irradiation, but it is not sufficiently grounded. Further experimental work is required. The work performed showed, however, that the materials tested, after undergoing a stage of relative decrease in strength, obtain under prolonged neutron irradiation satisfactory antifriction and strength characteristics and may be successfully used in friction joints. Work in this field, according to the present authors, should be directed toward the study of the wear resistance and setting of materials under neutron irradiation, in vacuum, at high temperatures, and in special media. Orig. art. has: 5 figures.

SUB CODE: 11, 18 / SUBM DATE: 13Oct64 / ORIG REF: 002 / OTH REF: 001

antifriction materials

18.

HW

Card 2/2

KOCHEGUROV, P.P., putevoy obkhodchik

My kilometer is always in excellent condition. Put' i put.khoz. no.12:28 D '58. (MIRA 12:1)

1. 17-ya distantsiya puti Yuzhnoy dorogi, stantsiya Solntsevo.
(Solntsevo--Railroads--Track)

SOV/144-59-7-13/17

AUTHORS: Chuchalin, I.P. (Cand. Tech. Sci., Director of Scientific-Research Institute); Bel'tyukov, Yu.N. (Assistant); Kochegurov, V.A. (Aspirant); Kuznetsov, V.M. (Senior Engineer); Soustin, B.P., (Junior Scientific Worker); and Strazdin, V.A. (Engineer)

TITLE: Parallel Connection of Valves for Switching Large Pulse Currents

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Elektromekhanika, 1959, Nr 7, pp 94-98 (USSR)

ABSTRACT: The basic requirements for satisfactory parallel operation of thyratrons, ignitrons, etc. are: simultaneous firing and equal voltage drops. These two factors are considered quite separately for the circuit in Fig 1, used for switching the charge from a bank of condensers to an electromagnet producing an intense magnetic field. Fig 2 shows the simpler case of two thyratrons connected directly to strings of condensers. If T_1 fires first C_2 will discharge more slowly than C_1. Fig 3 shows the variation in voltages of Fig 2. The anode of the second thyratron remains positive until the instant t_1 when $|U_2| > |U|$. If T_2 fires a negative voltage appears at the first anode since $U+U_2 > U+U_1$. T_1 extinguishes and

Card 1/3

Parallel Connection of Valves for Switching Large Pulse Currents

the load transfers to T_2. The exchange process repeats itself rapidly as shown in the oscillogram of Fig 4. To prevent the anode voltages becoming zero the circuit is modified by the introduction of the 2-core dividers shown in Fig 1. Fig 5 shows a convenient method of firing parallel-connected thyratrons. A sufficiently uniform distribution of current among the thyratrons is guaranteed by feeding their anodes through 2-winding transformers, interconnected as in the equivalent circuit of Fig 6 where the arc voltage-drops are represented by different e.m.f's. It is supposed that the latter are independent of current as are also the anode inductances. The increase in current in all the branches can be calculated as the transient arising from switching the e.m.f's across lossy inductances. The basic differential relation is Eq (1) and the solution for a particular current, i_1, is Eq (8). If it is required that the unbalanced current through any valve does not exceed a given amount then the necessary anode inductance is given by Eq (14). Confirmatory results have been obtained using type TR1-15/15 thyratrons.

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SOV/144-59-7-13/17

Parallel Connection of Valves for Switching Large Pulse Currents

There are 7 figures and 3 references, of which 2 are Soviet and 1 English.

ASSOCIATION: Nauchno-issledovatel'skiy institut, Tomskiy politekhnicheskiy institut (Scientific-Research Institute, Tomsk Polytechnical Institute); Fiziko-tekhnicheskiy fakul'tet (Physico-Technical Department), Tomskiy politekhnicheskiy institut (Tomsk Polytechnical Institute)

Card 3/3

8 (3)

AUTHORS: Razin, V. M., Candidate of Technical Sciences, Chuchalin, I. P., Candidate of Technical Sciences, Kocheturov, V. A., Engineer

SOV/105-59-8-12/28

TITLE: Design of Anode Current Dividers

PERIODICAL: Elektrichestvo, 1959, Nr 8, pp 54 - 57 (USSR)

ABSTRACT: This is an analysis of the three-anode current divider shown by figure 1. It is assumed that the voltage drop across the gas tube at the limit of the permissible maximum current is independent of the magnitude of the anode current. Hence the following approximations can be made: (1) Neglect of the ohmic resistances and the core losses of the current divider coils. (2) Neglect of the influence of the anode current divider and of the tubes upon the processes in the main circuit, and (3) the magnetic leakage between the windings. This implies that each winding has the same inductivity, and that the mutual inductivity is half the inductivity of one winding. The latter condition is satisfied if either the windings are zigzag connected, or, if each leg carries one winding, by providing for small air gaps. Anode current dividers must be designed as to secure ignition of each tube and a distribution of the mean and peak anode cur-

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rents which is uniform within a certain limit. The requirements for satisfying the first condition are investigated under the above assumptions. The formulas for the ignition of the first, second, and third tube are given, and formula (10) is derived for the case of n banked tubes in the circuit. The system of differential equations (11) holds for the simultaneous operation of all three tubes. Formula (15) specifies the average current carried by one tube, and formula (17) the mean current deviation. The irregularities of the distribution of the average anode currents are expressed in relative units (18), whereas formula (19) gives the inductivity of the divider windings for three, and (20) for the same, the latter when the circuit consists of n parallel branches. The control pulses arriving at the tube grids must have a very short rise time in order to reduce the ignition straying. The circuit shown in figure 2 appears to be best suited for this purpose. If the pulse repetition frequency is small, the irregularity of current distribution should be estimated not from the average value, but from the peak value. The inductivity of the divider is, for this case, given by formula (21). The authors also made experiments

on a parallel operation of tubes with multi-legged anode current dividers in a simple single-phase rectifier and with two-legged anode current dividers and separate capacitors for a commutation of the discharge current of the condensers. In both cases, favorable results were obtained. Under normal operating conditions none of the tubes showed ignition failure. The oscillograms of the total current and of the tube currents are shown by figure 4. There are 7 figures and 3 Soviet references.

ASSOCIATION: Tomskiy politekhnicheskiy institut (Tomsk Polytechnical Institute)

SUBMITTED: May 31, 1958

KOCHEGURA, V.V.; SHOLPO, L. Ye.

Magnetic stability of igneous rocks. Uch. zap. LGU no.286:149-156 '60. (MIRA 14:3)
(Rocks, Igneous--Mangetic properties)

KOCHEGURA, V.V.; SHOLPO, L. Ye.

Paleomagnetic investigation of Far Eastern basalts. Uch. zap. LGU no.286:160-164 '60. (MIRA 14:3)
(Soviet Far East--Magnetic properties)

S/169/62/000/001/081/083
D228/D302

AUTHOR: Kochegura, V. V.

TITLE: Paleomagnetic methods of rock age correlation

PERIODICAL: Referativnyy zhurnal Geofizika, no. 1, 1962, 30-31, abstract 1G221 (Sov. geologiya 4 no. 4, 1961, 47-59)

TEXT: The main hypotheses of paleomagnetism are discussed, and three methods are examined for the age correlation of rocks. The first method is constructed on the use of a definite scheme of migration for the earth's magnetic poles, this being drawn up from the data of paleomagnetic research. The broad application of this method at the present time is not possible on account of the too approximate and too fragmental knowledge about the history of the earth's magnetic field. The second method is a method of stratigraphically correlating sections and is based on compilation of zones with normal and reversed magnetization. This method includes the methods of correlation according to the disruptive field, magnetic susceptibility, and so forth. The described methods enable

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Paleomagnetic methods of ...

detailed differentiation and correlation to be made, but they do not permit determination of the age of rocks without introduction of other data. In the third method the degree of demagnetization of a rock is employed as the main parameter determining its age. A positive aspect of the method is that it does not require the selection of oriented specimens, and allows geologic collections and core material to be used for age measurements. For obtaining reliable conclusions about the age of a rock, however, it is necessary to measure a rather large number of specimens of this rock and to take into account the effect of a number of external factors -- for example, vibration, heating, etc. -- whose action leads to a change in the magnitude of remanent magnetization. 27 references. /Abstractor's note: Complete translation./

Card 2/2

KOCHEGURA, V.V.

KOCHEGURA, V. V. [Kochegura, V. V.]

Paleomagnetic methods for age correlation of rocks. Analele geol geogr 16 no.1:82-95 Ja-Mr '62.

KHRAMOV, A.N.; PETROVA, O.N.; KOMAROV, A.O.; KOCHEGURA, V.V.;
Prinimali uchastiye: DIANOV-KLOKOV, V.I.; PIONTKOVSKIY,
S.S.; YANOVSKIY, B.M., nauchnyy red.; RUSAKOVA, L.Ya.,
vedushchiy red.; GENNAD'IEVA, I.M., tekhn.red

[Methodology of paleomagnetic investigations] Metodika paleomagnitnykh issledovanii. Leningrad, Gos. nauchn.-tekhn.izd-vo neft. i gorno-toplivnoi lit-ry. Leningr. otd-nie, 1961. 130 p. (Leningrad. Vsesoiuznyi neftianoi nauchno-issledovatel'skii geologorazvedochnyi institut. Trudy, no.161) (MIRA 14:7)

1. Vsesoyuznyy neftyanoy nauchno-issledovatel'skiy geologorazvedochnyy institut (for Khramov). 2. Moskovskiy gosudarstvennyy universitet (for Petrova). 3. Vsesoyuznyy nauchno-issledovatel'skiy geologicheskiy institut (for Komarov, Kochegura). 4. Institut elementorganicheskikh soyedineniy (for Dianova-Klokova). 5. Institut fiziki Zemli AN SSSR (for Piontkovskiy). 6. Leningradskiy universitet (for Yanovskiy).
(Magnetism, Terrestrial)

YANOV, E.N.; PREDTECHENSKIY, N.N.; POLEVAYA, N.I.; MURINA, O.A.; MIRKINA, S.L.; ISKANDEROVA, A.D.; YEFIMOV, K.P.; CHEN' YUY-VEY [Ch'ên Yü-wei]; TITOV, N.Ye.; PANTELEYEV, A.I.; KOCHEGURA, V.V.; GIRFANOVA, O.M.; ZUYEV, A.V.; NIKOL'SKIY, Yu.I.; BURE, G.N.

Problems of the methods of geological investigations. [Trudy] VSEGEI 92:91-98 '63. (MIRA 17:4)

KOCHEGURA, V.V.

Paleomagnetic comparison of effusive complexes of the Far East.
Trudy VSEGEI 104:118-125 '64. (MIRA 18:1)

ACCESSION NR: AR4022443 S/0058/64/000/001/A039/A039

SOURCE: RZh. Fizika, Abs. 1A352

AUTHOR: Kochegurov, V. A.; Kuznetsov, V. M.; Chuchalin, I. P.

TITLE: Ionic switch for the excitation of the electromagnet of an accelerator with unipolar pulses

CITED SOURCE: Izv. Tomskogo politekhn. in-ta, v. 122, 1962, 116-118

TOPIC TAGS: accelerator, accelerator magnet, accelerator magnet pulse supply, ionic rectifier, ionic controlled rectifier, unipolar excitation pulse, pulsed capacitor charging, pulsed capacitor discharge

TRANSLATION: To increase the efficiency of an accelerator with pulsed magnet supply, it is proposed to use current pulses both to charge and to discharge the capacitor bank. The corresponding change

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ACCESSION NR: AR4022443

in the polarity of the windings is effected by means of two pairs of controlled ionic rectifiers, so connected that pulses of the same polarity are excited in the electromagnet winding. Each pulse can be used to accelerate the particles. The energy losses in the circuit are compensated by a rectifier whose polarity also is reversed in synchronism with the reversal of the polarity of the capacitor-bank voltage. V. Kanunnikov.

DATE ACQ: 03Mar64 SUB CODE: PH, SD ENCL: 00

Card 2/2

[redacted], Sofiya [illegible]; [redacted], [illegible]; [redacted], T.Ya., red.

[illegible] mineral ammonia fertilizers, from the practices of "Prigorodnyi" State Farm] Torfo-mineral'nye [illegible] udobreniia; iz opyta sovkhoza "Prigorodnyi." Leningrad, Kolos, 1965. 93 p. (MIRA 18:10)

BELLEN, Zygmunt; KOCHEL, Irena

Determination of small amounts of acetaldehyde in some organic solvents. Chem anal 6 no.2:195-199 '61. (KRAI 10:9)

J. Struszynski Analytical Department, Institute of General Chemistry, Warsaw.

(Acetaldehyde) (Solvents) (Organic compounds)

BELLEN, Zygmunt; KOCHEL, Irena;

Polarographic determination of terephthalic acid and its potassium salts in the presence of phthalic, toluic, and bensoic acids and their potassium salts. Chem anal 8 no.3: 411-413 '63.

1. M. Struszynski Analytical Laboratory, Institute of General Chemistry, Warsaw.

L 06435-67 EWT(1) IJP(c) AT

ACC NR: AP6026712 SOURCE CODE: UR/0181/66/008/008/2479/2481

AUTHOR: Gribnikov, Z. S.; Kochelap, V. A.; Rashba, E. I.

ORG: Institute of Semiconductors, AN UkrSSR, Kiev (Institut poluprovodnikov AN UkrSSR)

TITLE: Domain structure of a multitrough semiconductor during passage of strong currents

SOURCE: Fizika tverdogo tela, v. 8, no. 8, 1965, 2479-2481

TOPIC TAGS: semiconductor band structure, semiconductor carrier

ABSTRACT: Many semiconductors and semimetals have a multitrough band structure, and because of the anisotropy of the electric conductivity in each of the troughs, fluxes of electrons belonging to various troughs are oriented at an angle to the total current. If the intertrough relaxation time τ considerably exceeds the intratrough relaxation time, the spatial distribution of the carriers can be determined from a system of associated diffusion equations in which the scattering between troughs α and β is described by terms of the type $(n_\alpha - n_\beta)/\tau_{\alpha\beta}$. Under these conditions, an essential part is played by the characteristic length $L_{\alpha\beta} = \sqrt{D\tau}$. The characteristic field is $E_L = \epsilon/eL$, where $\epsilon = kT$ and ϵ_F respectively for a nondegenerate and a degenerate gas. Analysis of the limiting case where $E \gg E_L$ is given. An infinite plate of a monopolar semiconductor with thickness 2d ($-d \leq y \leq d$) is considered to which an electric field E is applied in direction Ox. The boundary conditions for electron fluxes of each of

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ACC NR: AP6026712

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the troughs are written down by introducing surface velocities of intertrough scattering s_{gs}. The case where 2d is considerably smaller than the drift length $L_E = LE/E_L$ is analyzed by means of diffusion equations with $E \gg E_L$. The case where $2d \gg L_E$ is also analyzed. A characteristic feature of almost all the cases considered is the appearance inside the plate at $E \to \infty$ of singular points (domain boundaries) at which the electron concentrations and the electric fields are different; the position of these points is determined by the conditions of the generation-recombination balance. Orig. art. has: 1 figure and 2 formulas.

SUB CODE: 20/ SUBM DATE: 07Feb66/ ORIG REF: 003

Card 2/2

L 08176-67 EWT(1) IJP(c) AT

ACC NR: AP6024888 SOURCE CODE: UR/0056/66/051/001/0266/0280

AUTHOR: Gribnikov, Z. S.; Kocholap, V. A.; Rashba, E. I. 48 8

ORG: Institute of Semiconductors, Academy of Sciences, Ukrainian SSR (Institut poluprovodnikov Akademii nauk Ukrainskoy SSR)

TITLE: Appearance of domains in "many-valley" semiconductors during the passage of strong currents

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 51, no. 1, 1966, 266-280

TOPIC TAGS: semiconductor band structure, semiconductor carrier, carrier density, electron distribution, semiconductor conductivity, electron scattering

ABSTRACT: The nonequilibrium density distribution of electrons in a many-valley semiconducting plate is analyzed for the limiting case of strong fields, which greatly disturb the carrier distribution in the valleys practically throughout the entire plate. Only many-valley semiconductors in which the intervalley scattering time is the longest relaxation time and is much longer than the characteristic times corresponding to all the intravalley relaxation processes are considered. The analysis shows that when a current giving rise to a strong electric field passes through a many-valley unipolar semiconducting plate, the electron currents in each of the valleys are directed at an angle to the electric field. The conditions of continuity of these currents in the interior and on the surface give rise to the splitting of the plate into several domains with boundaries parallel to the surface of the plate. The ef-

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ACC NR: AP6024888

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fects which appear in many-valley unipolar semiconductors in strong electric fields and give rise to the splitting of plates into domains are: nonlinearity of the volt-ampere characteristic, the appearance of a transverse electric field, a considerable rise in the transverse resistivity, rectification of the current in the case of unequal scattering rates and unequal slopes of the valleys, anisotropy of the conductivity, and partial or complete deletion of some electron valleys. Each domain contains as a rule only the electrons that belong to one valley, their number being such as to ensure electric neutrality. The number of domains is equal to or less than the number of valleys; if there are fewer domains than valleys, the electrons not included in the domains are always concentrated in a thin layer next to one of the surfaces of the plate and the surface electron density is greater than the equilibrium value. The sequential order of the domains is governed by the angles that the principal axes of the electric conductivity tnesors, corresponding to the different valleys, make with the surface of the plate. The number of domains and the positions of their boundaries depend on the ratio of the intervalley scattering rates in the interior and on the surface of the plate. The extent to which the simplifying assumptions made are satisfied is discussed. It is suggested in conclusion that the splitting of semiconductors into domains may cause other effects not considered in the paper, as well as appreciable changes in the galvanomagnetic properties. Orig. art. has: 6 figures, 64 formulas, and 2 tables.

SUB CODE: 20/ SUBM DATE: 31Jan66/ ORIG REF: 004/ OTH REF: 007

Card 2/2 nst

21015

S/058/61/000/005/023/050
A001/A101

9.2574
24.7900 (1144, 1163, 1055)

AUTHOR: Kochelayev, B.I.

TITLE: The effect of optical oscillations on paramagnetic spin-lattice relaxation in ionic crystals

PERIODICAL: Referativnyy zhurnal. Fizika, no 5, 1961, 176, abstract 5V346 (V sb. "Materialy 1-y konferentsii molodykh nauchn. rabotn. g. Kazani. Fiz.-tekhn. i matem. sektsiya". Kazan'. 1959, 63 - 67)

TEXT: The author detects the part of optical oscillations in the mechanism of spin-lattice relaxation. Kronig mechanism is considered. As a crystal the linear chain of atoms of two types is taken, in whose elementary cell are contained: a paramagnetic atom with mass m_α (spin $s = \frac{1}{2}$) and a non-magnetic atom with mass m_β. Only two-phonon processes are considered, since in single-phonon processes only audio frequencies play a part. It is assumed that $m_\alpha \gg m_\beta$. Under these conditions, in case of high temperatures (room) the contribution to the probability of relaxation transition, due to optical oscillations, is equal to the contribution from acoustic oscillations in order to magnitude. V. Strigutskiy
[Abstracter's note: Complete translation.]

Card 1/1

S/081/61/000/006/001/015
B101/B201

24.7900

AUTHOR: Kocholayev, B. I.

TITLE: Effect of optical vibrations upon the paramagnetic spin-lattice relaxation in ionic crystals

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 6, 196', 13 - 14, abstract 6L94 (6B94). (sb. "Materialy 1-y konferentsii molodykh nauchn. rabotn. g. Kazani. Fiz.-tekhn. i matem. sektsiya", Kazan', 1959, 63 - 67)

TEXT: A study has been made of the effect of optical vibrations upon the establishment of equilibrium between a system of electron spins and crystal lattice. The author has examined the case of a one-dimensional crystal containing two atoms of different masses in its cell. An equation has been derived for the probability of relaxation transition, which shows that contributions of optical and acoustic vibrations are in the same order of magnitude. It is noted that the Debye approximation for higher temperatures (of the order of room temperature) is not sufficient for a study of relaxation processes. [Abstractor's note: Complete translation.]

Card 1/1

KOCHELAYEV, B. I., Cand Phys-Math Sci, "Certain problems of the theory of spin-lattice interaction." Khar'kov, 1961. (Min of Higher and Sec Spec Ed UkSSR, Khar'kov Order of Labor Red Banner State Univ im A. M. Gor'kiy). (KL, 3-61, 204).

24 (2)

AUTHOR: Kochelayev, B. I.

SOV/56-37-1-37/64

TITLE: On the Theory of Spin-lattice Relaxation of Nuclear Spins in Ion Crystals (K teorii spin-reshetochnoy relaksatsii yadernykh spinov v ionnykh kristallakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 1(7), pp 242 - 248 (USSR)

ABSTRACT: The present paper presents a theoretical investigation of the spin-lattice relaxation of the nuclear spins caused by quadrupole interactions at high temperatures. At first, an operator of the spin-lattice interaction is derived, the form of which is a little more convenient than the form derived by J. Van Kranendonk (Ref 2). The author then investigates the case of a pure ionic bond. As in the afore-mentioned previous paper (Ref 2), it is assumed that the relaxing nuclei are contained in equivalent crystal fields, and that the influence of magnetic dipole-dipole interactions on the quadrupole relaxation can be neglected. Under these assumptions, the interaction of a single nucleus with the electric field of reflecting ions is calculated. Due to the modulation of this interaction by thermal vibrations, transitions between the individual spin states are induced. At

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first, a rather extensive expression is written down for that part of the Hamilton function which describes the quadrupole interaction of the nucleus with the crystal field. In order to obtain the operator of the spin-lattice interaction, the components of the gradient (a tensor) of the electric field (which is formed by a shifting of ions due to thermal vibrations) must be determined. The rather extensive expression resulting after some arithmetical operations for the operator of the spin-lattice interaction is explicitly written down. The next part of the present paper deals with the time of the spin-lattice relaxation. The further calculations are carried out for crystals of the NaCl-type. The resulting expressions for the transition probability and for the relaxation times for the cases $I = 3/2$ and $I = 5/2$ (rather extensive) are explicitly written down. The values T_1 calculated by these formulas (in sec) for the spin-lattice relaxation are compiled in a table together with the corresponding experimental values. The calculation results of other authors (Refs 3,4) are also indicated:

Ion	Experiment	acc.to K.Yosida etal. (Ref 3)	acc.to Wikner and Das (Ref 4)	Present Paper
Br^{79} in KBr	0.26	19.3	0.88	0.32
J^{127} in KJ	0.039	0.24	0.27	0.077
Br^{79} in LiBr	0.028	0.20	0.086	0.031

According to the results of the present papers, the Debye model is not suitable for an explanation of the relaxation effects of the spin system in the crystals at room temperature. A further more precise interpretation of the theory requires an accurate determination of the amplitudes and of the spectral density of the natural vibrations of the lattice, and the consideration of the influence exerted by the covalence on the relaxation effect. This influence of the covalence on the relaxation is only unim-

On the Theory of Spin-lattice Relaxation of Nuclear Spins in Ion Crystals SOV/56-37-1-37/64

portant. The relaxation time derived here is much longer than the experimental one if spins of another kind (which can relax more rapidly) are present in the substance investigated. The author thanks S. A. Al'tshuler for the subject suggested and for his interest in the present paper. There are 1 table and 15 references, 6 of which are Soviet.

ASSOCIATION: Kazanskiy gosudarstvennyy universitet (Kazan' State University)

SUBMITTED: February 12, 1959

Card 4/4

KOCHELAYEV, B.I.

82532

S/181/60/002/007/007/042
B006/B070

24.7900

AUTHOR: Kochelayev, B. I.

TITLE: The Theory of Spin-Lattice Relaxation of Paramagnetic Ions in XY_6 Complexes

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 7, pp. 1423-1427

TEXT: The purpose of this work was to investigate theoretically the paramagnetic spin-lattice relaxation in crystals in which a paramagnetic ion X is surrounded by six diamagnetic particles Y arranged in the form of an octahedron. In the introduction, Van Vleck's theory is discussed, and it is shown that one of the fundamental assumptions of this theory is not correct in most cases, including such as have been dealt with by Van Vleck. This assumption is that any change in the distance between X and Y is due only to acoustic Debye waves, that is to say, that the Y-particles are bound to X and the surrounding particles with forces of the same order. Spectroscopic analyses have shown that some complexes in molecular crystals retain their individual properties, and the effect

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S/181/60/002/007/007/042
B006/B070

The Theory of Spin-Lattice Relaxation of Paramagnetic Ions in XY_6 Complexes

of the crystal lattice is to be considered only as a perturbation. This is true, for example, of the complex $Cr(H_2O)_6$, which retains almost unchanged its characteristic frequency of $\sim 5 \cdot 10^3 cm^{-1}$ in different compounds; relative to its neighbors, however, it oscillates with a frequency of $\sim(1 \div 5) \cdot 10^2 cm^{-1}$. The spin-lattice interaction in such crystals is theoretically studied. For this purpose, it is assumed that the interaction is due to electric forces between X and Y. An expression for the spin-lattice interaction operator is derived, and its matrix elements are determined. Later, spin-lattice relaxation is investigated for high temperatures where the two-phonon processes are already of importance; formula (6) is given for the probability of relaxation transitions. The numerical data agree for potassium chrome alum. Finally, the results are discussed, and compared with those of Van Vleck, and some important differences are indicated. The ratio of spin-lattice relaxation times for alum and corundum, according to Van Vleck, for single-phonon processes is $\left(\frac{\tau_{alum}}{\tau_{cor}}\right)_1 \simeq 10^{-3}$, for two-phonon processes at

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KOCHELAYEV, B.I.

Longitudinal relaxation of nuclear spins at superlow temperatures in a paramagnetic crystal. Zhur.eksp.i teor.fiz. 38 no.3:999-1000 Mr '60. (MIRA 13:7)

1. Kazanskiy gosudarstvennyy universitet.
(Nuclear spin)

69989

24.4500

AUTHOR: Kochelayev, B. I.

S/020/60/131/05/018/069
B013/B007

TITLE: The Influence of the Imperfections of a Crystal Upon Spin-lattice Relaxation

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol 131, Nr 5, pp 1053-1056 (USSR)

TEXT: The scattering of waves by the defects of a crystal causes small amplitude changes of the oscillations, and may cause relative shifts of the nearest atoms which are many times larger than those due to Debye waves. In his calculations, the author used the theory by I. M. Lifshits (Refs 1, 2) of the oscillations of non-ideal lattices. The operator of spin-lattice interaction is a function of the spin-coordinates and of the shift of the atom with spin relative to the surrounding particles. Here, only the relative shifts of such particles must be known as are symmetrically arranged around a paramagnetic center. The author considers only the nearest particles. The single-atom crystal lattice is assumed to have a defect at the point with the radius vector $\vec{R}$. An expression for the amplitude of the relative shifts of two particles caused by a plane wave is given. There follows an expression for the influence of the crystal-defects upon the spin-lattice relaxation. In two-phonon processes, the influence exerted by the defects may be insignificant. In direct processes, the above-mentioned condition is

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The Influence of the Imperfections of a Crystal Upon Spin-lattice Relaxation

S/020/60/131/05/018/069
B013/B007

nearly always satisfied. The defectiveness of the crystal is assumed to consist in the fact that in one of the atoms all interaction coefficients are replaced by a certain quantity ξ. The author then investigates, as a concrete example, the relaxation of the ion Cr^{3+} in an octahedral surrounding. The corresponding operator of spin-lattice interaction is explicitly written down. For the probability of a relaxation transition with the production of one phonon, $A_{pq} = \frac{2\pi}{\hbar^2} \varrho_\omega | \langle p, n | \mathcal{H}_{s-1} | q, n+1 \rangle |^2$ holds as usual. Here ϱ_ω denotes the spectral density of the lattice oscillators, n - the quantum number of the oscillator, p and q - the spin levels, $\mathcal{H}_{s-1}$ is the operator of spin-lattice interaction. After some intermediate calculations one finds:

$$A_{pq} = \frac{96\pi^4}{h} \frac{a^2 \xi^2 \omega}{|\overline{R}_0 - \overline{R}^e|^4 \Omega^2 \varrho v^7} \frac{\exp(h\omega/kT)}{\exp(h\omega/kT)-1} W_{pq} \; ; \; W_{p,q} = \varepsilon_1^2 \left[\left| \chi_{pq}^{(2)} \right|^2 + \left| \chi_{pq}^{(3)} \right|^2 \right] +$$

$$+ \varepsilon_2^2 \left[\left| \chi_{pq}^{(4)} \right|^2 + \left| \chi_{pq}^{(5)} \right|^2 + \left| \chi_{pq}^{(6)} \right|^2 \right] .$$ Here ω denotes the frequency of the "spin-quantum", ϱ - the density of the crystal, and $v_1 = v_2 = v_3 = v$ holds. This

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The Influence of the Imperfections of a Crystal Upon Spin-lattice Relaxation

S/020/60/131/05/018/069
B013/B007

transition probability depends also on the distance between the paramagnetic atom and the defect, which causes a dependence of the relaxation time τ on the concentration of the paramagnetic centers. With $\hbar\omega \ll kT$ the frequency-dependence of the "spin-quantum" vanishes. Somewhat more complicated is the case in which the paramagnetic atom itself represents the defect. The influence exerted by the crystal defects upon the spin-lattice relaxation of the nuclear spins is of especial importance. In the interval of from 14 to 20° K, the dependence of τ on T and also of their value on τ may easily be explained by two-phonon processes. However, at 2 to 4° K, τ is more than 10 times shorter in the case of a crystal powder than in that of a single crystal, nor does it depend on magnetic field strength. This may be fully explained by the above formula for A_{pq}. For the final clarification of the influence exerted by the defects in spin-lattice relaxation, special experiments are necessary. The author thanks S. A. Al'tshuler for his advice as well as for discussing the results. A. M. Prokhorov and A. A. Manenkov are mentioned in the paper. There are 6 references, 3 of which are Soviet.

ASSOCIATION: Kazanskiy gosudarstvennyy universitet im. V. I. Ul'yanova-Lenina (Kazan' State University imeni V. I. Ul'yanov-Lenin)

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69989
S/020/60/131/05/018/069
B013/B007

The Influence of the Imperfections of a Crystal Upon Spin-lattice Relaxation

PRESENTED: December 14, 1959, by I. Ye. Tamm, Academician

SUBMITTED: December 11, 1959

Card 4/4

27191 S/056/61/041/002/012/028
B102/B205

24,1200 (1144, 1147, 1327)

AUTHOR: Kochelayev, B. I.

TITLE: Relaxation absorption of sound in a paramagnetic

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41, no. 2 (8), 1961, 423-428

TEXT: S. A. Al'tshuler, who developed the theory of resonance absorption of sound in a spin system, was the first to investigate the effect of the generation of sound waves on the spin system of a paramagnetic. The present paper deals with a theoretical study of sound absorption in paramagnetic crystals due to relaxation between the spin system and the thermal lattice vibrations. Calculations were performed in a semiphenomenological manner with the use of a method developed by L. I. Mandel'shtam, M. A. Leontovich, and I. G. Shaposhnikov, by which the behavior of systems subjected to time-dependent perturbations can be analyzed in a thermodynamical manner. It is assumed that the paramagnetic can be divided into two weakly interacting subsystems, i. e., the spin system and the system of the remaining degrees of freedom. The thermodynamic state of the latter (the lattice) is assumed to be independent of the state of the spin system,

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Relaxation absorption of sound in a ... 081/056/61/041/002/012/028
B102/B205

i. e., the spin-lattice relaxation time $\tau \gg \tau_s$, where τ_s is the spin-spin relaxation time. In addition, the temperature of the paramagnetic is assumed not to be too low. In thermodynamic equilibrium, the spin system is characterized by $T=T_{lat}$ and by the external field H. The author considers a small crystal range, whose linear dimensions, L, are small compared with the sound wavelength ($L \ll \lambda$), but is large enough to be considered in a macroscopic manner. It is further assumed that during sound propagation, both subsystems pass through a series of successive equilibrium states. This assumption requires a sound frequency much greater than $\omega \ll 1/\tau_s$. The sound waves are assumed to propagate along the z-axis, so that only one component of the deformation tensor must be taken into account: $u_{zz}=u=u_0 \cos(qz)e^{i\omega t}=u'e^{i\omega t}$. At small sound amplitudes, the deviations from the equilibrium state are assumed to be small, so that calculation in linear approximation with respect to the small quantities u is possible ($\zeta=\sigma-\sigma_0$, $\theta=T-T_0$, $\theta_{lat}=T_{lat}-T_0$); $\sigma=\sigma(u,H,T)=-\partial\Psi/\partial u$, where Ψ is the free energy of the spin system in the presence of an $\vec{H}$-field,

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and σ is a generalized force. $\zeta/u = \zeta = \zeta' - i\zeta''$, ζ' and ζ'' are real quantities. The amount of energy absorbed per unit time is given by $\bar{\dot{E}} = \frac{1}{2}\omega\zeta''(u')^2$. The amount of heat δQ exchanged between the spin system and its neighborhood is composed of the amount of heat $\delta Q' = -\varkappa_1(T-T_{lat})dt = -\varkappa_1(\theta-\theta_{lat})dt$ transferred to the lattice during the time dt, and of the amount of heat $\delta Q'' = -dt\int \mathrm{div}(-\varkappa_2 \mathrm{grad} T)dV$ transferred to the remaining spin system. $\varkappa_1$ is the heat-conduction coefficient between spin system and lattice, and $\varkappa_2$ is that of the spin system. The relation $\delta Q'' = \varkappa_2 \nabla^2\theta$ holds for $L \ll \lambda$ (L are the dimensions of V). The lattice vibrations may be considered to be adiabatic at any point. Then, the temperature deviation of the lattice is $\theta_{lat} = -Bu$, and one obtains $\theta = [T(\gamma_{Tu})_0 i\omega - B\varkappa_1]/[i\omega c_H + \varkappa_1 + \varkappa_2\nabla]$, where c_H indicates the specific heat of the spin system at constant H. The following expression is thus obtained for the imaginary part of sonic susceptibility per unit volume:

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$$\zeta'' = -\left[\frac{T\,(\gamma_{Tu})_0(1 + \varkappa_2\tau\omega^2/v_1^2C_H) + BC_H}{(1 + \varkappa_2\tau\omega^2/v_1^2C_H)^2 + \omega^2\tau^2}\right] \frac{(\gamma_{Tu})_0\omega\tau}{C_H} \quad (8), \text{ where}$$

$\tau = C_H/\varkappa_1$ is the spin-lattice relaxation time, and C_H is the specific heat; $\psi = \gamma/V$. The sound absorption coefficient per unit volume is then found to be

$$\alpha = \frac{1}{\rho v_1^3 k^2 T^3 C_H^2 \eta}\left[\mathrm{Sp}\,\hat{\mathcal{H}}_0\hat{F} - \frac{1}{\eta}\mathrm{Sp}\,\hat{\mathcal{H}}_0\,\mathrm{Sp}\,\hat{F}\right]^2 \frac{\omega^2\tau}{1 + \omega^2\tau^2} \quad (13).$$ Next, the author presents some numerical estimates of α for typical paramagnetics. The estimates are made for paramagnetic ion salts (ion spin $S > 1/2$ and $S = 1/2$) and finally discussed. In the first case, $\alpha \approx 10^{-6}\,cm^{-1}$ is obtained at $\omega = 3\cdot10^7$ cps, T=300°K, H=0, and $\tau = 0.5\cdot10^{-8}$ sec. In the second case ($H=10^4$ oe): $\alpha \approx 10^{-5}\,cm^{-1}$. It is concluded that the theoretically investigated effect must be experimentally observable. S. A. Al'tshuler is thanked for discussions. There are 7 references: 5 Soviet

Relaxation absorption of sound in a ... S/056/61/041/002/012/028 B102/B205

and 2 non-Soviet. The reference to the English-language publication reads as follows: J. H. Van Vleck. Phys. Rev., 57, 426, 1940.

ASSOCIATION: Kazanskiy gosudarstvennyy universitet (Kazan' State University)

SUBMITTED: February 3, 1961

Card 5/5

30397
S/053/61/075/003/002/005
B125/B104

24,1600 (1063, 1144, 1482)

AUTHORS: Al'tshuler, S. A., Kochelayev, B. I., Leushin, A. M.

TITLE: Paramagnetic sound absorption

PERIODICAL: Uspekhi fizicheskikh nauk, v. 75, no. 3, 1961, 459 - 499

TEXT: This is a review of papers on paramagnetic sound absorption, published in the years 1951 to 1961. It is divided into the following chapters: introduction; paramagnetic resonance absorption of sound; crystals containing ions of the iron group; ions with the effective spin $S'>1/2$; effect on Ni^{2+} ions on an MgO crystal; ions with the effective spin $S' = 1/2$; crystals containing ions of rare-earth elements; crystals containing paramagnetic ions in the S-state; Waller's mechanism; acoustic paramagnetic resonance and spin-lattice relaxation in ionic crystals; metals; experimental studies of electron-induced acoustic paramagnetic resonance; nuclear acoustic paramagnetic resonance; experimental studies of nuclear acoustic paramagnetic resonance; shape of the acoustic paramagnetic resonance line; pulse methods used to investigate acoustic paramagnetic resonance; non-resonant paramagnetic absorption of sound; some conclusions

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30397
S/053/61/075/003/002/005
B125/B104

Paramagnetic sound absorption

of the authors: All the effects under consideration are similar to the action of an r-f electric field on paramagnetics. All the principal effects produced by an electromagnetic field in paramagnetics (resonance, spin induction, spin echo, relaxation absorption) can be obtained by means of a sound field. Paramagnetic sound absorption may occur in almost every substance in which also paramagnetic absorption of an r-f electromagnetic field is observable. There are no indications of spin-phonon interaction in solid, free radicals. In liquid and gaseous paramagnetics, paramagnetic sound absorption is weak. Studies of paramagnetic sound absorption can give additional information on the properties of matter, especially on the properties of spin-phonon interaction. The selection rules to be applied to acoustic paramagnetic resonance are different from those to be used for transitions induced by an electromagnetic field. In general, effects produced by sound are by several orders of magnitude stronger than effects induced by an electromagnetic field. The authors refer to Ye.K. Zavoyskiy, B. I. Kochelayev (FTT, 2, 1423 (1960), DAN SSSR 131, 1053 (1960)), A. B. Kessel' (ZhETF 36, 1451 (1959)). There are 5 figures, 5 tables and 68 references: 28 Soviet and 40 non-Soviet. The three most recent references

Card 2/3

S/181/62/004/006/027/051
B104/B112

AUTHOR: Kochelayev, B. I.

TITLE: Resonance rotation of the plane of polarization of sound waves in a paramagnetic material

PERIODICAL: Fizika tverdogo tela, v. 4, no. 6, 1962, 1559 - 1563

TEXT: An investigation of the resonance phenomena during the passage of transverse sound waves through a paramagnetic crystal reveals a resonance rotation of the plane of polarization of the waves. The dependence of the angle of rotation on the frequency of the wave and on the strength of the magnetic field is studied. The angle of resonance rotation is estimated, and it is shown that the effect must be experimentally observable in most salts of the metals of the iron group. It should also be possible to observe the rotation of the plane of polarization in metals. This appears to be of importance for the investigation of the absorption and dispersion of the electromagnetic field produced by a skin effect.

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S/181/62/004/006/027/051
B104/B112

Resonance rotation of...

ASSOCIATION: Kazanskiy gosudarstvennyy universitet im. V. I. Ul'yanova-Lenina (Kazan' State University imeni V. I. Ul'yanov-Lenin)

SUBMITTED: January 29, 1962

Card 2/2

S/181/62/004/011/032/049
B108/B102

AUTHORS: Aminov, L. K., and Kochelayev, B. I.

TITLE: Spin-lattice interaction in crystals containing individual paramagnetic complexes

PERIODICAL: Fizika tverdogo tela, v. 4, no. 11, 1962, 3273 - 3276

TEXT: Corrections accounting for the inhomogeneity of a crystal (different atoms or complexes, different binding forces) are calculated for the spin-lattice interaction Hamiltonian. The considerations are based on a bi-atomic chain in which only the interactions between nearest neighbors are taken into account. The Hamiltonian for the Debye model of oscillations has to be multiplied by a factor $K = \frac{1}{a(a+b)} \frac{(m_1+m_2)^2}{m_1 m_2} (1 + \beta/\alpha) \frac{v^2}{\omega_{opt}^2}$ for single-phonon processes, and by K^2 for two-phonon processes. a and b are the distances between the particles of one cell and the nearest particles of the neighboring cell, v is the phase velocity of the low-frequency

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Spin-lattice interaction in...

sound. α and β, respectively, are the coupling constants for particles within one cell and for particles of two adjacent cells. The corrections to the relaxation times of single and two-phonon processes are then $\tau^{(1)} = \tau^{(1)}_{Debye} K^{-2}$ and $\tau^{(2)} = \tau^{(2)}_{Debye} K^{-4}$. If the temperatures are not too high (and the optical vibrations still low) these approximations agree well with experimental results.

ASSOCIATION: Kazanskiy gosudarstvennyy universitet im. V. I. Ul'yanova-Lenina (Kazan' State University imeni V. I. Ul'yanov-Lenin)

SUBMITTED: June 29, 1962

Card 2/2

24.2200

37600
S/056/62/042/005/025/050
B102/B104

AUTHORS: Aminov, L. K., Kochelayev, B. I.

TITLE: Additional spin-spin interaction due to phonon field effect in paramagnetic crystals

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 42, no. 5, 1962, 1303-1306

TEXT: The spin-spin interaction in paramagnetics is normally regarded as an effect of exchange and magnetic dipole-dipole interaction. The former is a contact interaction and the latter occurs by way of a photon field, since, however, the spins are also related to the phonon field, an interaction through that field must exist. This is investigated here by using the quantum field theory. The energy of spin-spin interaction is stated for the case in which retardation can be neglected. The matrix for interaction of paired spins is obtained through the application in second approximation of the bonds of the scattering matrix in which averages of the phonon state were used. It is connected with the perturbation energy by the relationship

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Additional spin-spin interaction ...

$S_{ij}^{(2)} = -2\pi i U_{ij}\delta(\hbar\omega_{mn} + \hbar\omega_{m'n'})$, where ω represents the phonon frequencies. The energy operator of direct spin-spin interaction by the phonon field is given via

$$U_{ij}^{\beta} = A r_{ij}^{3} \sum_{\alpha,\beta=1}^{3} \varepsilon_{\alpha\beta}\varepsilon_{\alpha}\varepsilon_{\beta} F^{\alpha}(S_i) F^{\beta}(S_j), \quad A = R^{5}(2\pi\rho v^{2})^{-1}; \qquad (5);$$

here $F(\vec{S})$ are spin functions, ε_{α} characterizes the spin-phonon interaction, r_{ij} is the distance between i-th and the j-th lattice point R is the dimension of the complex examined ($R \ll \lambda$, the phonon wavelength), ϱ is the crystal density, v is the velocity of sound and $s = f(\vec{r}/r)$, being of the order of unity. The effect of the interaction under consideration is estimated and its effect on the shape of the paramagnetic resonance lines determined. It is shown that the part played by this interaction is an important one, $(\Delta\nu)^2$ being from 1 to 2 orders of magnitude lower than for a resonance line caused solely by magnetic dipol-dipol interaction. This applies to most ions of the elements in the iron group. To sum up, an additional bonding energy between the crystal ions exists and can be brought into play by the interaction of orbital spin of bound electrons via a phonon field. If the separation of energy levels is less than the

Card 2/3

Additional spin-spin interaction ...

Debye temperature, the bonding energy is considerable. S. A. Al'tshuler is thanked for discussions.

ASSOCIATION: Kazanskiy universitet (Kazan' University)

SUBMITTED: December 10, 1961

Card 3/3

KOCHELAYEV, B.I.

Resonance rotation of the polarization plane of sound in a paramagnetic. Fiz. tver. tela 4 no.6:1559-1563 Je '62. (MIRA 16:5)

1. Kazanskiy gosudarstvennyy universitet imeni V.I.Ul'yanova-Lenina.
(Polarization (Sound)) (Paramagnetism)

AMINOV, L.K.; KOCHELAYEV, B.I.

Effect of spin-phonon interaction on the paramagnetic resonance spectrum. Fiz. tver. tela 4 no.6:1604-1607 Je '62. (MIRA 16:5)

1. Kazanskiy gosudarstvennyy universitet imeni V.I.Ul'yanova-Lenina.
(Paramagnetic resonance and relaxation) (Nuclear spin)

AMINOV, L.K.; KOCHELAYEV, B.I.

Spin-lattice interaction in crystals containing evolved paramagnetic complexes. Fiz. tver. tela 4 no.11:3273-3276 N '62. (MIRA 15:12)

1. Kazanskiy gosudarstvennyy universitet imeni V.I. Ul'yanova-Lenina.
(Paramagnetic resonance and relaxation)
(Crystal lattices)

KOCHELAYEV, B.I.

Antiferromagnetism due to spin-phonon interaction. Zhur. eksp. i teor. fiz. 44 no.1:235-239 Ja '63. (MIRA 16:5)

1. Kazanskiy gosudarstvennyy universitet.
(Nuclear spin) (Magnetism)

L 1314-66 EWT(1)/EPF(c) LJP(c) WW/GG

ACCESSION NR: AR5014398 UR/0058/65/000/004/D038/D038

SOURCE: Ref. zh. Fizika, Abs. 4D285

AUTHOR: Koloskova, N. G.; Korepanov, V. D.; Kochelayev, B. I.

TITLE: Shape of the curve for the nuclear induction signal

CITED SOURCE: Sb. Itog. nauchn. konferentsiya Kazansk. un-ta za 1962 g. Kazan', Kazansk. un-t, 1963, 4-5

TOPIC TAGS: nuclear physics, nuclear resonance, resonance absorption, resonance line

TRANSLATION: The authors propose an explanation for the oscillating decay in the nuclear resonance signal based on the resonance absorption line $g(\nu)$ in the form $g(\nu) = A(a^2 - \nu^2)^p$, where A and a are constants. The curve for $g(\nu)$ is rectangular at $p = 0$ and Gaussian at $p = \infty$. Methods are given for finding the parameters A, p and a. R. Yul'met'yev.

SUB CODE: MP ENCL: 00

Card 1/1

L 9243-66 EWT(1)/EWA(m)-2 IJP(c) AT

ACC NR: AP5022742 SOURCE CODE: UR/0181/65/007/009/2859/2860

AUTHOR: Kochelayev, B. I.

ORG: Kazan State University im. V. I. Ul'yanov-Lenin (Kazanskiy gosudrastvennyy universitet)

TITLE: Spin-spin interactions through conduction electrons in semiconductors

SOURCE: Fizika tverdogo tela, v. 7, no. 9, 1965, 2859-2860

TOPIC TAGS: semiconductor theory, spin wave theory, conduction electron

ABSTRACT: Exchange interaction of localized spins with conduction electrons leads to indirect spin-spin exchange (Kittel-Ruderman interaction). The magnitude of this exchange decreases with distance as r^{-3}, oscillating with a period determined by the wave vector on the Fermi surface. These oscillations are due to a logarithmic singularity of the Fourier transform in the momentum space for spin susceptibility of the degenerate electron gas at the point $p = 2p_F$ (p_F is the wave vector of an electron on the Fermi surface). It was previously shown that this singularity is smoothed out by blurring of the Fermi distribution level with momentary interaction between electrons. In this case, the relationship between indirect exchange and distance is somewhat weakened. Blurring of the Fermi distribution level when the temperature is increased

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Card 2/2

L 2451-66 EWT(1) LJP(c)

ACCESSION NR: AP5024708 UR/0056/65/049/003/0862/0866

AUTHOR: Al'tshuler, S. A.; Kochelayev, B. I.

TITLE: Shift of the fine structure components of the Rayleigh scattering line in paramagnetics

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 3, 1965, 862-866

TOPIC TAGS: fine structure, Rayleigh scattering, paramagnetic material, spin phonon interaction, laser, paramagnetic ion

ABSTRACT: The Rayleigh scattering effect was used to study the spin-phonon interaction in paramagnetics, making it possible to avoid the usual experimental difficulties associated with generation of sound at phonon frequencies (10^{10}—10^{11} cps), when observation of the acoustic paramagnetic resonance is impossible due to line broadening. A shift in the fine structure components of a Rayleigh line was postulated as a result of frequency coincidence of a scattering phonon and one of the divisions of spin levels of a paramagnetic ion. As an example of the postulated effect, an MgO crystal, doped with Ni^{2+} and Fe^{2+} (whose spin-

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L 2451-66 3

ACCESSION NR: AP5024708

spin-phonon interactions are well known) was considered. Other crystals containing V^{3+}, Cr^{4+}, and Ti^{3+} are also suitable. The effect can be observed particularly well in crystals containing ions of rare earths with an even number of electrons, and also in liquids. Since the shift in the velocity of sound is proportional to the difference of spin level populations, the greatest shift can be expected at low temperatures, when the intensity of Rayleigh scattering is greatly reduced. For this reason, the use of a laser as a light source is warranted. Possible experiments for observing the scattering of light with simultaneous saturation of the paramagnetic resonance lines are discussed. Orig. art. has: 10 formulas. [YK]

ASSOCIATION: Kazanskiy gosudarstvennyy universitet (Kazan' State University)

SUBMITTED: 18Mar65 ENCL: 00 SUB CODE: NP, EM

NO REF SOV: 002 OTHER: 002 ATD PRESS: 4109

Card 2/2

L 21732-66 EWT(1) IJP(c) WW/GG SOURCE CODE: UR/0020/66/166/004/0833/0835

ACC NR: AP6008042

AUTHOR: Kochelayev, B. I.

ORG: Kazan State University im. V. I. Ul'Yanov-Lenin (Kazanskiy gosudarstvennyy universitet)

TITLE: Hyperfine structure of the Rayleigh line for scattering of light in a paramagnetic crystal

SOURCE: AN SSSR. Doklady, v. 166, no. 4, 1966, 833-835

TOPIC TAGS: paramagnetic material, hyperfine structure, line splitting, Rayleigh scattering

ABSTRACT: The author considers scattering of light in a paramagnetic crystal and shows that additional splitting of each component in the fine structure of the Rayleigh scattering line should take place under certain conditions. Interaction between the spin system and the phonons in the paramagnetic crystal is discussed. Analytical formulas are derived which indicate that oscillations are generated by the spin-phonon interaction which are neither purely lattice vibrations nor spin oscillations. The greatest interspersion of these oscillations takes place in the

UDC: 535.337

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L 21738-66
ACC NR: AP6008042

region where the frequencies of the normal modes coincide. Hyperfine splitting is evaluated from data on acoustical paramagnetic resonance in a magnesium oxide crystal containing a bivalent iron cation with a concentration of $7.5 \cdot 10^{-5}$. The numerical value found for the splitting is approximately 3 Gc. Methods similar to those used in this paper may be applied to analysis of neutron-phonon scattering since the scattering cross section is determined by the same correlation functions. The author thanks S. A. Al'tshuler for discussing the results of this work. Orig. art. has: 6 formulas.

SUB CODE: 20/ SUBM DATE: 15Jun65/ ORIG REF: 004/ OTH REF: 001

Card 2/2 ULR

L 29549-66 EWT(1)/T IJP(c) GD

ACC NR: AT6014767 SOURCE CODE: UR/0000/64/000/000/0078/0097

66
B+1

AUTHOR: Kochelayev, B. I.

ORG: none

TITLE: Theory of some paramagnetic phenomena due to spin-phonon interaction

SOURCE: Paramagnitnyy rezonans (Paramagnetic resonance); sbornik statey. Kazan, Izd-vo Kazanskogo univ., 1964, 78-97

TOPIC TAGS: electron paramagnetic resonance, spin phonon interaction, crystal theory, spin system, quantum mechanics, operator equation

ABSTRACT: A number of phenomena which take place in a paramagnetic crystal due to interaction between the spin system of the paramagnetic material and lattice vibrations are theoretically analyzed. The thermal capacity of the lattice acts as a thermostat with respect to that of the spin system since the former is much greater than the latter over a wide temperature range. The spin-lattice interaction results in energy exchange so that any excitation of the system disappears after a certain relaxation time without any significant change in the state of the phonon gas. Continuous excitation of the spin system results in energy disippation by the excitation source due to these irreversible processes. Quantum-mechanical expressions are given for calculating the absorption of energy in an alternating magnetic field parallel to a constant field.

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L 29549-66

ACC NR: AT6014767

Only that part of the absorption which is caused by spin-phonon interaction is considered. The interaction between spins and lattice vibrations gives a basis for using sound as the source for excitation of the spin system. The absorption of acoustic energy in the paramagnetic material due to interaction between spins and thermal phonons as well as spin-spin interaction is calculated. It is shown that the polarization plane is rotated when a transverse polarized acoustic wave passes through the paramagnetic crystal. This phenomenon displays resonance properties. An operator is derived for spin interaction through a phonon field. Some problems associated with paramagnetic resonance saturation are discussed. Orig. art. has: 68 formulas.

SUB CODE: 20/ SUBM DATE: 04Jun64/ ORIG REF: 013/ OTH REF: 008

Card 2/2 FV

L 04697-67 EWT(1)/EWP(k) IJP(c) WG/RM/GG/JT/JXT(CZ)
ACC NR: AP6029742 SOURCE CODE: UR/0053/66/089/004/0719/0723

AUTHOR: Kaganov, M. I.; Kochelayev, B. I.; Peschanskiy, V. G.

ORG: none

TITLE: Twelfth All-Union Conference on Low-Temperature Physics

SOURCE: Uspekhi fizicheskikh nauk, v. 89, no. 4, 1966, 719-723

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ABSTRACT: The Twelfth All-Union Conference on Low-Temperature Physics, held 25—29 June 1965 in Kazan', dealt with investigations (using resonance methods) of condensed systems at low temperatures. More than 100 reports were presented at the conference, which was attended by approximately 300 Soviet scientists. The introductory address was given by P. L. Kapitsa.

The work of the conference was divided into four sections. Section 1 was concerned with electron spectra in non-conducting crystals; Section 2, with dynamic phenomena in non-conducting crystals; Section 3, with the

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Mossbauer effect; and Section 4, with resonance phenomena in metals and semiconductors.

Electron Spectra in Non-Conducting Crystals

Particular attention was given to investigations of the microstructure of impurity crystals involving electronic and paramagnetic resonance (EPR and NMR) methods and optical spectroscopic studies. A large body of reports was devoted to the study of the structure of the environment of rare-earth ions in CaF_2-type crystals.

M. M. Zaripov, V. S. Kropotov, and L. D. Livanova reported on their discovery of the superfine structure of the EPR spectrum of the Mn^{2+} and Co^{2+} ions in MgF_2 resulting from fluorine nuclei.

R. A. Zhitnikov, I. V. Kolesnikov, and A. L. Orbeli reported on their methods for the stabilization of free atoms in molecular-type media at the temperature of liquid nitrogen.

S. A. Al'tshuler and R. M. Valishev discovered a ferromagnetic-type exchange coupling between Ni^{2+} ions in zinc fluosilicate. From an analysis

of the EPR spectra of various types of exchange pairs they determined the value of the exchange integral.

Dynamic Phenomena in Non-Conducting Crystals

The process of equilibrium establishment in spin-systems was discussed in detail. V. A. Atsarkin found that a two-staged process of spin-lattice relaxation takes place. In such a process, the excessive heat of the spin-system is transferred to thermal lattice oscillations by means of the rapid relaxation of the "exchange pairs." S. A. Peskovatskiy investigated the spin-lattice relaxation of chromium ions in ruby in the absence of an external magnetic field and concluded that in a wide range of chromium concentrations the "exchange pairs" do not contribute substantially to the relaxation of individual ions.

Mossbauer Effect

Included in the reports given in this section were studies of the anisotropy of the Mossbauer effect in single crystals of white tin over a wide temperature range, the inversion of the anisotropy effect and possible causes for this phenomenon, and the phenomena occurring when the Mossbauer effect is under the influence of some additional electromagnetic or sonic field.

Resonance Phenomena in Metals and Semiconductors

Yu. V. Sharvin and L. M. Fisher discussed their experiments on the production and observation of a focused electron beam in metal.

Many of the reports were concerned with experimental investigations of the energy spectrum of conduction electrons with the aid of resonance methods. L. A. Fal'kovskiy, in a theoretical investigation of the energy spectrum of current carriers in bismuth in a magnetic field, showed that at an arbitrary direction of the magnetic field, the spin-splitting of the energy levels in bismuth considerably exceeds the spin-splitting of levels of free electrons.

P. A. Bezuglov, V. D. Fil', and O. A. Shevchenko reported on observing nonlinear effects in the absorption of ultrasound (at frequencies of 115, 160, and 210 Mcps) in superconducting indium.

I. Ye. Dzyaloshinskiy discussed the theory of magnetic structures in antiferromagnetic metals. The appearance of such structures, he found, is linked with the exchange interaction of conduction electrons with spins of magnetic ions.

Other reports discussed the Fermi surface of some metals and its investigation by means of cyclotron resonance and magnetoacoustic methods.

At the final session session N. Ye. Alekseyevskiy summed up the work of the conference. It was resolved that an all-union conference on low-temperature physics and engineering be held in 1967 at Khar'kov.

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