VYVAL'KO, I.G.; DUSHECHKIN, A.I. [deceased]; LUSHCHEVSKAYA, G.M.; MATKOVSKIY, K.I.; SAVINOV, B.G.; SHILOV, Ye.A.; YASNIKOV, A.A.

Biosynthesis of carotene. Vitaminy no.4:159-163 '59. (MIRA 12:9)

1. Institut organicheskoy khimii Akademii nauk USSR i Institut zemledliya Ministerstva sel'skogo khozyaystva USSR, Kiyev.
(CAROTENE)

BILAY, V.I.; VERNER, D.A.; ZAKORDONETS, A.I.; LUSHCHEVSKAYA, G.M.

A stimulant of plant growth isolated from Fusarium miliforme Sheld. Izv. AN SSSR. Ser. biol. 27 no.1:42-47 Ja-F '62. (MIRA 15:3)

1. Akademiya nauk Ukrainskoy SSR, Kiyev.
(FUSARIUM)
(GROWTH PROMOTING SUBSTANCES)

KUCHAYEVA, A.G.; ZENEVICH, V.Ye.; LUSHCHEVSKAYA, G.V.; SHIROKOV, O.G.

Conditions of gibberellin formation by different Fusarium strains. Izv. AN SSSR. Ser. biol. no.2:271-277 Mr-Ap '61. (MIRA 14:3)

1. Institut mikrobiologii Akademii nauk SSSR i Institut mikrobiologii i organicheskoy khimii Akademii nauk USSR, kafedra biologii pochvy Moskovskogo gosudardarstvennogo universiteta imeni M.V.Lomonosova.
(GIBBERELLINS) (FUSARIUM)

SHELUD'KO, I., kandidat tekhnicheskikh nauk; LUSHCHEVSKIY, B., inzhener.

Gas-fired water heater. Zhil.-kom.khoz. 6 no.5:26-28 '56. (MLRA 9:11)
(Water heaters)

KUSHCHEVSKIY, V.

Innovator of the Riga harbor. Sov. profsoiuzy 7 no.14:37-38 Jl '59.
(MIRA 12:10)

(Riga--Harbor)

LUSHCHEVSKIY, V. P.

4756. LUSHCHEVSKIY, V. P. Opyt skorostnoy obrabotki sudov v kaliningradskom morskom portu. m. mor. transport. 1954. 36s. so skhem 20 sm. (b-ka po obmenu opytom na mor. transporte). 1,000 ekz. 55k na obl. zagl. serii: 13-ka obmena opytom na mor. transporte, (54-58048)P 656.61.073.2 st.

SO: Letopis' Zhrunal nykh Statey, Vol. 7, 1949

LEPESHKOV, Stepan Ivanovich; MEDVEDEV, Fedor Konstantinovich; LUSHCHEVSKIY, V., red.; AKIS, I., tekhn. red.

[From the bottom of the sea] So dna moria. Riga, Latviiskoe gos. izd-vo, 1962. 196 p. (MIRA 16:1)
(Baltic Sea--World War, 1939-1945--Naval operations--Submarine)

LUSHCHEVSKIY, Ya. (Riga)

All difficulties can be overcome in a close-knit group. Sov. profsoiuzy 16 no.18:28-30 S '60. (MIRA 13:10)
(Riga--Ships--Maintenance and repair)

LUSHCHEVSKIY, Ya., red.; SPURANE, V., tekhn. red.

[Soviet Baltic Republics in the fraternal family of Soviet peoples] Sovetskaia Pribaltika v bratskoi sem'e narodov SSSR; materialy. Riga, Latviiskoe gos. izd-vo. Vol.6. 137 p. (MIRA 14:11)

1. Mezhrespublikanskiy seminar-soveshchaniye, Riga, 1960.
(Baltic States--Economic conditions)

S/138/62/000/010/007/008
A051/A126

AUTHORS: Gul', V.Ye., Lushcheykin, G.A.

TITLE: A method of investigating electric charges occurring in repeated deformations of vulcanizates

PERIODICAL: Kauchuk i rezina, no. 10, 1962, 51 - 52

TEXT: A method has been developed to determine the magnitude and sign of electric charges forming in repeated deformations of polymers at various temperatures (from -100 to +200°C), and deformation frequencies from 16 to 14 cps. The suggested method, using the instrument shown in Figure 1, can also be applied to investigate the relation of polymer deformation to temperature and deformation frequency. The charge generated in one cycle was determined accumulated in deformation on electrodes and sample. The 30-53 (EO-53) AC oscillograph was used for this purpose, with an additional amplifier (Fig. 2). The magnitude and sign of the charge were estimated from a curve on the oscillograph. The charge maghitude was determined in two different ways: a) by measuring the maximum pulse V, in volts and calculating the charge magnitude, from the formula: Q = CV (C -

Card 1/2

A method of investigating electric charges ....

capacitance of the ingoing circuit); b) by measuring the energy W, entering the system per cycle from the transmitter, consumed either for the charge of the ingoing capacitance C, $W = CV^2 = \frac{Q^2}{C}$, or for the heating of the total resistance circuit:Z: $W = \frac{U^2}{fZ}$, where U is the acting value of the voltage, v; f - frequency, cps. From the latter two formulae an expression for calculating the charge per cycle is derived: $Q = U\sqrt{\frac{C}{fZ}}$. Similar results are obtained from both methods. There are 3 figures.

ASSOCIATION: Moskovskiy institut tonkoy khimicheskoy tekhnologii im. M.V. Lomonosova (Moscow Institute of Fine Chemical Technology im. M.V. Lomonosov)

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40576
S/070/62/007/005/013/014
E132/E460

AUTHORS: Gul', V.Ye., Lushcheykin, G.A., Fridkin, V.M.

TITLE: Electrets from elastic polymers

PERIODICAL: Kristallografiya, v.7, no.5, 1962, 797-799

TEXT: The production of electrets by the orientation of molecules in an electric field while the specimen is heated and cooled is well-known. However, the production of electrets by cross-linking (vulcanization) has hitherto not been described. The possibilities of forming very high stability electrets by this method are obvious. For these experiments natural rubber with the usual content of vulcanizing compounds (100 parts by wt. rubber, 3 parts sulphur, 1 part mercaptobenzothiazol, 5 parts ZnO) but without a filler. The mixture was vulcanized in a press under a pressure of 70 kg/cm^2 between sheets of Al foil which were insulated from the press by 6 to 8 layers of cellophane. Fields of 5 to 10 kV/cm were applied during the process. Heterocharges were formed for low fields and homocharges for higher fields. The change of heterocharge with time could be expressed by

$$s = s_1 \exp(-t/\tau_1) + s_2 \exp(-t/\tau_2)$$

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S/070/62/007/005/013/014
E132/E460

Electrets from elastic polymers

where τ_1 = 110 min and $\tau_2 = 10^4$ min. The heterocharge is thus due to two mechanisms, the first dipole orientation (relaxation time τ_1) and the second the macroscopic displacement of the ions the long relaxation time of which (τ_2) is due to the high specific resistance of the material. The production of charges of the same sign on both sides of the sheet can be explained by the different numbers of positive and negative ions moving towards the electrodes. Besides the surface charging the piezomodulus was also measured. The latter was found to be directly proportional to the surface density of the charge and reached a value of 10^{-7} c.g.s.u. The full time of vulcanization was 30 min at 143°C. After vulcanization, specimens could not be electrified and it is clear that the electrets are locked in by the vulcanization. There are 3 figures.

ASSOCIATIONS: Moskovskiy institut tonkoy khimicheskoy tekhnologii im. M.V.Lomonosova (Moscow Institute of Fine Chemical Technology imeni M.V.Lomonosov)
Institut kristallografii AN SSSR (Institute of Crystallography AS USSR)

SUBMITTED: January 16, 1962

Card 2/2

L 14283-63 EPR/EWP(j)/EPF(c)/EWP(q)/EWT(m)/BDS AFFTC/ASD Ps-4/Pr-4/
Pc-4 RM/WW/JD
ACCESSION NR: AP3004083 S/0069/63/025/004/0412/0417

AUTHOR: Dogadkin, B. A.; Gul', V. Ye.; Lushcheykin, G. A.

TITLE: Study of electric charges produced during the multiple deformation of vulcanizates and their effect on fatigue strength

SOURCE: Kolloidny*y zhurnal, v. 25, no. 4, 1963, 412-417

TOPIC TAGS: vulcanizate, vulcanizate multiple deformation, compression electric-charge formation, electric-charge measurement, lithium butadiene rubber, nitrile rubber, unloaded vulcanizate, loaded vulcanizate, carbon-black conductive structure, inner orientation, polarization, outer-surface charge buildup, vulcanizate fatigue strength, Reznikovskiy machine, fatigue strength, compression electric charge

ABSTRACT: The effect of temperature, polymer type, and filler on the magnitude of electric charges produced during multiple deformation in the compression of vulcanizates has been studied by means of the two apparatus whose diagrams are shown in Fig. 1 of the Enclosure. In apparatus I, [maximum] deformation is constant (condition 1), and the charge is determined by measurement of peak voltage

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ACCESSION NR: AP3004083

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at the lower electrode. In apparatus II deformation is conducted under constant load (condition 2), and the charge generated during one cycle is first amplified and then computed. The experiments were conducted with lithium butadiene (SKBM) or nitrile (SKN-18, SKN-26, SKN-40) rubbers having an identical degree of cross-linking. The effects of polymer type and temperature are presented in the form of plots, shown in Figs. 2 and 3. The charges are maximum under condition 1 at temperatures somewhat below and under condition 2, somewhat above the glass transition temperatures. In channel black-loaded vulcanizates the charges are minimum for black contents corresponding to maximum development of a continuous carbon black conductive structure. Discussion of the results indicates that charges are produced both owing to inner orientation polarization and to outer-surface charge buildup. The effect of electric charges on the fatigue strength of carbon black-loaded butadiene-styrene (SKS-30A), natural, 1,4-cis-polyisoprene (SKI), and carboxylated (SKS-30-1) rubber vulcanizates was studied with incised specimens, which were subjected to bending-torsion tests on the Reznikovskiy machine. Fatigue strength was lowered by charges produced during the deformation of the vulcanizates. This phenomenon is considered to be the result of the generation of voltages which can activate both oxidation and degradation and of the rearrangement of vulcanization linkages. The fatigue strength of carbon black vulcanizates

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L 14283-63
ACCESSION NR: AP3004083

during multiple deformation can be increased by grounding the electric charges. Orig. art. has: 5 figures and 2 tables.

ASSOCIATION: Moskovskiy institut tonkoy khimicheskoy tekhnologii (Moscow Institute of Fine Chemical Technology)

SUBMITTED: 16Feb63	DATE ACQ: 15Aug63	ENCL: 03
SUB CODE: CH, MA	NO REF SOV: 004	OTHER: 003

Card 3/3

DOGADKIN, B.A.; GUL', V.Ye.; ANFIMOV, B.N.; LUSHCHEYKIN, G.A.

Dielectric properties of unfilled vulcanizates of various structure. Koll.zhur. 25 no.5:515-519 S-O '63. (MIRA 16:10)

1. Moskovskiy institut tonkoy khimicheskoy tekhnologii im. M.V.Lomonosova.

GUL', V.Ye.; LUSHCHEYKIN, G.A.; DOGADKIN, B.A.

Electric charges due to the deformation of polymers. Dokl. AN SSSR 149 no.2:302-304 Mr '63. (MIRA 16:3)

1. Moskovskiy institut tonkoy khimicheskoy tekhnologii im. M.V.Lomonosova. Predstavleno akademikom V.A.Karginym.
(Polymers) (Polarization (Electricity)) (Deformations (Mechanics))

L 25738-65 EPF(c)/EPR/EPA(s)-2/EWP(j)/EWT(m)/T Pc-4/Pr-4/Ps-4/Pt-10 RM/WW
ACCESSION NR: AP3001569 S/0069/63/025/003/0334/0340

AUTHOR: Lushcheykin, G. A.; Gul', V. Ye.; Dogadkin, B. A.

TITLE: Investigation of electric charges occurring during deformation of polymers

SOURCE: Kolloidnyy zhurnal, v. 25, no. 3, 1963, 334-340

TOPIC TAGS: electrochemistry, polymer deformation, polymer dielectric, rubber property, rubber research, electroelastic effect

ABSTRACT: The purpose of this work was to investigate the nature of the electroelastic phenomenon and the effect of different factors on it. The investigation of the development of electric charge during deformation of rubber was conducted under static compression as well as under static expansion conditions. In both cases methods were used which would minimize the possibility of producing charge due to friction or producing contact potential difference. The obtained results indicate that the observed effect is not caused by the orientation of dipoles in the dielectric or by any special deformation of the vector of polarization, but is a result of a change in the charge density on the surface during deformation of the specimens. The initial development of charge on the specimens, which is responsible for the electroelastic effect, may occur as a result of electret type

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L 25738-65
ACCESSION NR: AP3001569

bulk polarization. The electret state was obtained in vulcanized rubber as a result of orientation under the action of the mechanical field of chain molecules, containing polar groups. The stability of the polarization increases with an increase in the degree of crosslinking and with a reduction in the relaxation time of the macromolecular segments. "In conclusion the authors express their gratitude to the senior research fellow V. M. Fridkin for his valuable suggestions during the discussion of this work." Orig. art. has: 12 figures and 2 tables.

ASSOCIATION: Institut tonkoy khimicheskoy tekhnologii, Moscow (Institute of Fine Chemical Technology)

SUBMITTED: 21Dec62 ENCL: 00 SUB CODE: MT, EM

NO REF SOV: 005 OTHER: 004

Card 2/2

L 03033-67 EWP(j)/EWT(m)/T IJP(c) RM

ACC NR: AP6023065 (A) SOURCE CODE: UR/0191/66/000/004/0038/0040

AUTHOR: Antonov, S. N.; Gurman, I. M.; Kovriga, V. V.; Lushcheykin, G. A.

37
36
B

ORG: none

TITLE: Electric properties of epoxy resins of different molecular weight

SOURCE: Plasticheskiye massy, no. 4, 1966, 38-40

TOPIC TAGS: epoxy plastic, dielectric property, dielectric loss, molecular weight

ABSTRACT: The authors studied the effect of molecular weight, temperature, and time of curing on the angle of dielectric losses (tg δ), dielectric permeability (ε), and specific electric volume resistivity (ρ_v) of epoxy resins ED-5, ED-6, and ED-L (see Table 1), obtained by condensation of diphenylolpropane and epichlorohydrin. Dielectric properties of the noncured resins improved with an increase in molecular weight and as their curves of $tg\,\delta = f(t)$ and $\varepsilon = f(t)$ shifted toward higher temperatures. The values of dielectric properties of pured resins decreased with an increase in molecular weight. The curing conditions of the epoxy resins affected tgδ more than ε or ρ_v. Orig. art. has: 5 fig. and 1 table.

UDC: 678.643'42'5.01 : 537.226

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L 03033-67

ACC NR: AP6023065

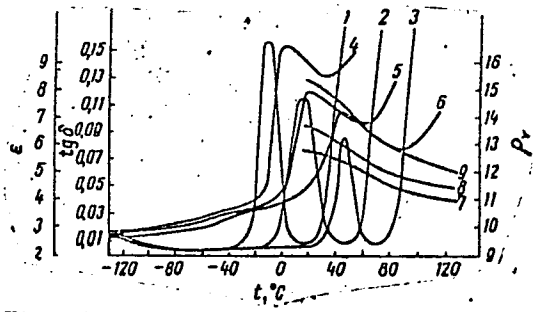

Figure 1. Dependence of tg δ (1-3), ε (4-6), and ρ_v (7-9) of the noncured resins on temperature; 1, 4, 7-ED-5 resin; 2, 5, 8-ED-6 resin; 3, 6, 9-ED-L resin

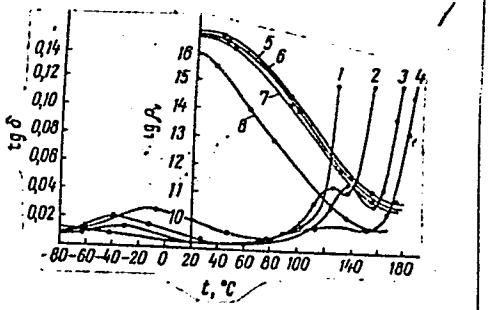

Figure 2. Dependence of tg δ and ρ_v of the cured resins on curing temperature; tg δ : 1-ED-5; 2-ED-L; 3-ED-6; 4-ED-5; ρ_v : 5-ED-5; 6-ED-6; 7-ED-L; 8-ED-5; 1 and 8 were cured by diethylenetriamine and 2, 3, 4, 5, 6, and 7 by maleic anhydride

Table 1. Characteristics of epoxy resins

Resin	Concn., %	Mol. weight	Melting temp., C
ED-5	20.6	350-400	-8-0
ED-6	16.3	450-550	8-15
ED-L	9.3	800-1000	40-60

SUB CODE: ~~20~~, 11/ SUBM DATE: none/ ORIG REF: 005/ OTH REF: 002

Card 2/2

5(4) SOV/69-21-3-6/25

AUTHORS: Gul', V.Ye. and Lushcheykin, Yu.G.

TITLE: The Effect of Molecular Interaction on the Electric Strength of Vulcanizates

PERIODICAL: Kolloidnyy zhurnal, 1959, Vol XXI, Nr 3, pp 283-288 (USSR)

ABSTRACT: The authors report on an investigation intended to ascertain the dependence of the electric strength of pure vulcanizates on the intensity of molecular interaction (the magnitude of specific cohesional energy). For the experiments samples 0.1 ÷ 0.4 mm thick were used, in order to reduce the heterogeneity of the field. The experiments were carried out so as to ensure an electric breakdown, a procedure utterly suitable to set forth the effect of the nature of the polymer. The experiments proved the statistical character of the electric strength (which has much in common with mechanical strength): the character of the distribution curves, the dependency of

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The Effect of Molecular Interaction on the Electric Strength of Vulcanizates

electrical and mechanical strength on the thickness of the sample and its temperature. In the field of high elastic states molecular interaction does not exercise a remarkable influence on electric strength. In the field of transition from a high-elastic to a vitrified state, however, the factors which determine the mobility of the links of chain molecules, exercise a considerable effect on electric strength. The experiments further proved that the maximum value of electric strength is directly proportional to the specific cohesional energy, provided that the remaining characteristics of the chemical character of the polymer remain unchanged. With the lowering of temperature, the electric strength of vulcanizates increases, reaching a maximum at the temperature of vitrification. It decreases, however, at a further lowering of the temperature. The authors ascertained a linear dependency between maximum electric strength and vitrification temperature for rubbers of similar chemical

The Effect of Molecular Interaction on the Electric Strength of Vulcanizates

structure. In the field of transition from the high-elastic to the vitrified state electric and mechanical strength are characterized by analogous dependencies on different factors (measures of the sample, temperature, period of activity of the mechanical or electrical field, specific cohesional energy of the high-polymers). The authors mention the Soviet scientist G.M. Bartenev [Ref 11]. There are 8 graphs, 2 diagrams and 13 references, 12 of which are Soviet and 1 English.

ASSOCIATION: Moskovskiy institut tonkoy khimicheskoy tekhnologii im. M.V. Lomonosova (Moscow Institute of Fine Chemical Technology imeni M.V. Lomonosov)

SUBMITTED: 26 December, 1957

GERSHANOK, R.A., inzh.; PROKHOROV, V.N., inzh.; LUSHCHIK, B.A., inzh.

Block segmented prestressed concrete trusses lacking struts and with a span of up to 36 m. Prom. stroi. 40 [i.e. 41] no.4: 17-24 Ap '63. (MIRA 16:3)

1. Proyektnyy institut No.1 Gosstroya SSSR (for Gershanok). 2. Leningradskoye otdeleniye Vsesoyuznogo gosudarstvennogo proyektnogo instituta stroitel'stva elektrostantsiy (for Prokhorov). 3. Trest Sevenergostroy (for Lushchik).
(Trusses) (Prestressed concrete)

LUSHCHIK, Ch. B.

Dissertation: "Investigation of Electron Centers of Attraction in Alkali-Halide Crystallophosphors by the Method of Thermal Irradiation." Cand Phys-Math Sci, Leningrad State U, Leningrad, 1954. Referativnyy Zhurnal--Khimiya, Moscow, No 13, Jul 54.

SO: SUM No. 356, 25 Jan 1955

LUSHCHIK CH. B.

USSR/Physics - Spectral analysis

Card 1/1 Pub. 43 - 26/62

Authors : Lushchik, Ch. B.

Title : The spectrum of electron entrapment levels in alkali-halide crystallo-phosphorus

Periodical : Izv. AN SSSR. Ser. fiz. 18/6, page 687, Nov-Dec 1954

Abstract : The spectrum of thermal activation energies was investigated for the entrapment centers of fifteen crystallophosphori to determine the inertia characteristics of the compounds. It was found that a predominant majority of entrapment centers represents thermal microdefects of the basic substance and is in no way connected with the presence of activator ions in the crystal. It was also observed that the spectrum of electron entrapment levels becomes highly complicated if the phosphorus base is in the form of a mixed crystal. Two references: 1 USSR and 1 USA (1949-1951).

Institution: Acad. of Sc., Est. SSR, Inst. of Physics and Astronomy

Submitted : .....

Lushchik, Ch.B.

USSR / Optics K

Abs Jour: Referat Zhur-Fizika, 1957, No 4, 10374

Author : Lushchik, Ch.B.
Inst : Not Given
Title : Recombination Mechanism of Afterglow of Certain Crystal Phosphors.

Orig Pub: Tr. In-ta fiz. i astronom. AN EstSSR, 1955, No 1, 57-71

Abstract: A parallel investigation of the thermal glow (TG) of KCl-TlCl phosphor, exposed to X-rays at 20° C and of the thermal discoloration of the F and M bands (550 and 850 millimicrons) in KCl crystal exposed to X-rays has shown that the temperatures of the maximum velocity of discoloration of F and M bands (410 and 325° K respectively) coincides with the temperatures of the thermal glow peaks (PTG). Preliminary exposure of the excited phosphor of KCl-TlCl to light at λ = 555 or 850 millimicrons attenuates the peaks at 410 and 325° K respectively. Analogous coincidence is observed between the temperature of the discoloration of the

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USSR / Optics K

Abs Jour: Referat Zhur-Fizika, 1957, No 4, 10374

Z_1 band and $KCl-CaCl_2$ and the PTG temperature (360° K) of the $KCl-CaCl_2$ -TlCl phosphor. It is concluded that the presence of different PTG is due to the localization of the electrons in various capture centers, present already in the pure basic matter and independent of the glow centers (ions of the activator). This, in the author's opinion, proves the probability of their recombination phosphorescence in alkali-halide phosphors. The following glow mechanism is proposed: the light excites the activator ions. Part of these is converted into the ground state with radiation of fluorescence and part is ionized. With this, the electrons are localized at the defects of the fundamental lattice (F, M, and other centers), on the impurities (Ca^{++}, Sr^{++} etc.), and on the activator ions (Tl^{+}). The recombination of the freed electrons with the ionization glow centers passes through an excited state of the latter. It is established that in the phosphors $CdBr_2$-Pb, $CdBr_2$-Mn

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USSR / Optics

K

Abs Jour: Referat Zhur-Fizika, 1957, No 4, 10374

and $CdBr_2$-Au there are the same localization levels, and the glow spectrum is characteristic for the activator ions. Conclusion is reached that the prolonged afterglow of all the above phosphors is of recombination character. Bibliography, 36 titles.

Card : 3/3

LUSHCHIK, CH.B.

USSR / Optics K

Abs Jour: Referat Zhur-Fizika, 1957, No 4, 10380

Author : Klement, F.D., Lushcrik, Ch.B.
Inst : Not Given
Title : Diffusion of Activator in Alkali-Halide Crystal Phosphors.

Orig Pub: Tr. In-ta fiz. i astronom., AN EstSSR, 1955, No 1, 72-94

Abstract: An investigation was made of the diffusion of ions of Cu^+, Ag^+, Pb^{++}, and Tl^+ in single crystals of KCl and NaCl in the temperature range from 500 to 740°. A layer of activator (CuCl, AgCl, $PbCl_2$ and TlCl) was distilled on single-crystal plates of the base in vacuum, was heated for 30 minutes, flaked into layers approximately 0.01 cm each, and the absorption spectrum was measured for each layer. The coefficient of absorption k_m at the maximum of the activator band of absorption is proportional to the activator concentration in the layer and makes possible determination of various characteristics of diffusion from the curves $k_m = f(x)$ where

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USSR / Optics

K

Abs Jour: Referat Zhur-Fizika, 1957, No 4, 10380

x is the distance from the surface of the crystal to the investigated layer. The depth of penetration (i.e., the depth at which k_m is $\underline{e}$ times less than on the surface) of the ions in KCl after 30 minutes at 740° is (in centimeters): Cu^+ 0.21, Ag^+ 0.052, Pb^{++} 0.014, Tl^+ < 0.01; in NaCl the values are Cu^+ 0.097, Ag^+ 0.016. The activation energy Q for the diffusion of the Cu^+ and Ag^+ ions in KCl is respectively 1.1 and 1.4 ev. For K^+ in KCl, according to the data in the literature, q = 1.6 ev. This difference is attributed to the fact that the radii of the Cu^+ and Ag^+ ions are less than in K^+. Bibliography, 31 titles.

Card : 2/2

LUSHCHIK, CH. B.

"Study of Trapping Centers in Crystals by the Method of Thermal Extinquishing," by Ch. B. Lushchik, Institute of Physics and Astronomy, Academy of Sciences Estonian SSR, Izv. AN Est-SSR 1955, No 2, pp 217-229 (from Referativnyy Zhurnal -- Fizika, No 10, Oct 56, Abstract No 29780)

"The method consists in plotting curves of the absorption coefficient k_m ratio at maxima of various additional absorption bands of the excited crystal to the temperature T at uniform heating. A theoretical analysis of the curves $k_m = f(T)$ permits determination of the thermal energies of ionization E_T of trapping centers and the correlation between the recombination probabilities P_p and a recurrent trapping P_3 of freed electrons. For alkali haloid crystals $P_3 \ll P_p$. On the basis of coincidence of temperatures of the maximum velocity of decoloring of x-irradiated KCl with peak temperatures of thermal glowing of phosphor KCl = TlCl it is concluded that the peaks are produced by the freeing of electrons from F- and M- centers. An analogous coincidence of KCl = $CaCl_2$ and KCl = $CaCl_2$ = TlCl shows that the peak of thermal glowing at 365 °K is produced by ionization of Z_1 -bands at 580 mμ (Cu^+ ions). It was computed from experimental data that E_T for F-centers in KCl and Z_1 -bands in KCl = $CaCl_2$ and KCl = $SrCl_2$ equals, respectively, 1.02, 0.86, and 0.80 ev."

SUM. 1287

Lushchik, Ch. B.

K-5

USSR/Optics - Physical Optics

Abs Jour : Referat Zhur - Fizika, No 5, 1957, 12931

Author : Lushchik, Ch.B.

Inst : Institute of Physics and Astronomy, Academy of Sciences, ESTONIAN USSR

Title : Concerning the Theory of Thermal Glow.

Orig Pub : Dokl. AN SSSR, 1955, 101, No 4, 641-644

Abstract : The author considers the optimum conditions of thermal glow of crystal phosphors for the case of small probability of repeated localizations of electrons on the capture centers compared with the probability of the recombination with the ionization centers of the glow. An analysis is made of the dependence of such quantities as dispersion, resolving power, and light intensity of the thermal-glow method on the experimental conditions.

Card 1/2

USSR/Optics - Physical Optics, K-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35774

Author: Lushchik, Ch. B.

Institution: Institute of Physics and Astronomy, Academy of the Estonian SSR, Tartu

Title: Energies of Thermal Ionization of Dye Centers in Alkali-Haloid Crystal Phosphors

Original Periodical: Dokl. AN SSSR, 1955, 101, No 5, 833-836

Abstract: Using the curves for the thermal glow of crystals of NaBr, KCl, KBr, and KI, activized by copper, silver, and thallium, the energy of the thermal ionization E_T and the factor P_0 in the equation for the probability of the thermal ionization of dye centers: $p = P_0 \exp(-E_T/kT)$ was determined. The majority of the peaks of the thermal glow is independent of the activator and of other admixtures and corresponds to thermal ionization of the dye centers in pure alkali-haloid crystals. The connection between the individual peaks

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USSR/Optics - Physical Optics, K-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35774

Abstract: [illegible] the thermal glow and the absorption bands of the dye centers is established by selective optical decolorizing of the individual bands. For the F-centers the values of E_T are (ev): NaCl -- 1.03, NaBr -- 0.78, KCl -- 1.03, KBr -- 0.82, and KI -- 0.65. The values, calculated by S. I. Pekar (Issledovaniya po elektronnoy teorii kristallov [Investigations on the Electron Theory of Crystals], 1951) are in poor agreement with the experimental data. The causes of the discrepancy are analyzed.

Card 2/2

Lushchik, Ch. B.

USSR/Optics - Physical Optics K-5

Abs Jour : Referat Zhur - Fizika, No 5, 1957, 12946

Author : Lushchik, Ch.B.
Inst :
Title : Method of Thermal-Optical Glow.

Orig Pub : In-ta fiz. i actron. AN EstSSR, 1956, No 4, 42-52

Abstract : A new sensitive method is proposed for the investigation of the capture centers and for the kinetics of the relaxation processes in phosphors, a method based on the measurement of the brightness of the optical flash of glow at different instants of time after cessation of the excitation, with heating the phosphor with a constant velocity ("method of thermal-optical glow"). The influence of thermal luminescence is eliminated by modulating the glowing light and recording the glow by means of an electron multiplier. The influence of the temperature extinction is elimenated by working in a pulsed heating mode with

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Lushchik, Ch. B.

USSR/Physical Chem. Crystals B-5

Abs Jour : Ref Zhur - Khimiya, No 7, 1957, 22128

Author : Ch. B. Lushchik, F. N. Zaitov
Inst : Not given
Title : Relaxation processes in phosphors with a complex spectrum of penetration levels.

Orig Pub : Tr. In-ta fiz, Astron. AN Est SSR, 1956, No 4, 53-80

Abstract : Thermal decolorization and thermo-optic luminosity in the system of impulse heating are the object of this study in order to permit an examination of the distribution of electrons (E) and holes on the levels of penetration. Stimulated phosphor is submitted to constant heating until it reaches a temperature T_1 and then it is quickly cooled to T_o. At T_o the spectrum of absorption of stimulated phosphor or the spectrum of stimulation of the optical flash are measured. After that the temperature again is quickly increased to T_1 then the phosphor is submitted to constant heating up to T_2. At that point the temperature is rapidly lowered to T_o and so on. The examination of the absorption of the stimulated KCl-$CaCl_2$-AgCl and NaCl-AgCl showed that the distribution of E and

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LUSHCHIK, CH. B.

Category: USSR / Physical Chemistry - Crystals B-5

Abs Jour: Referat Zhur-Khimiya, No 9, 1957, 29733

Author : Lushchik Ch. B.
Inst : Academy of Sciences Esthonian SSR
Title : Anisothermal Relaxation Processes in Crystalphosphors

Orig Pub: ENSV teaduste Akad. toimetised. Tehn. ja fuus.-matem. teaduste seer., Izv. AN estSSR, Ser. tekhn. i fiz.-matem. n., 1956, 5, No 1, 12-21

Abstract: Methods available for the investigation of relaxation processes (determinations of temperature dependence of luminosity of thermoluminescence, conductance and photodielectric effect) are considered, and methods are proposed for thermal decolorization (determination of dependence of absorption coefficient of capture centers upon temperature on uniform heating of excited phosphor) and thermal-optical deexcitation (periodical determination of the luminosity of optical flash on uniform heating of excited phosphor). The two last mentioned methods, and the method based on determination of photodielectric effect, make it possible to utilize impulse heating conditions, which is most

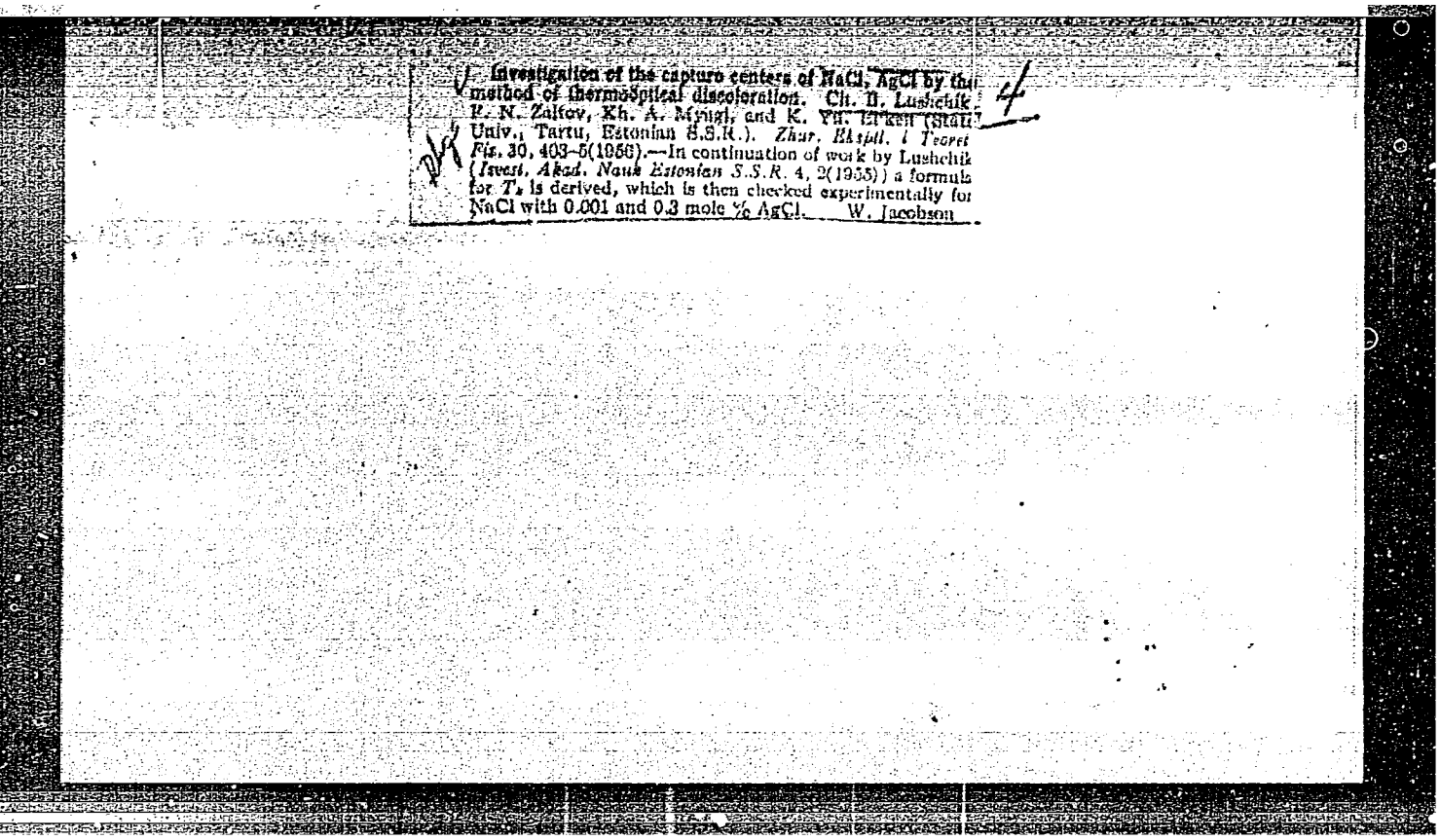
Card : 1/2 -28-

Category: USSR / Physical Chemistry - Crystals B-5

Abs Jour: Referat Zhur-Khimiya, No 9, 1957, 29733

advantageous in the case of investigation of phosphors having a complex spectrum of capture levels. Basic theoretical correlations between experimentally determined quantities and elemental characteristics of the phosphor, are given. Some applications are considered of the method of thermal decolorization and of the method of thermal-optical de-exitation, in the study of mechanism and kinetics of luminescence and investigations of capture centers of phosphors.

Card : 2/2



Investigation of the capture centers of NaCl, AgCl by the method of thermooptical discoloration. Ch. B. Lushchik, P. N. Zaitov, Kh. A. Myagi, and K. Yu. Ilmet (State Univ., Tartu, Estonian S.S.R.). *Zhur. Eksptl. i Teoret. Fiz.* 30, 403–5(1956).—In continuation of work by Lushchik (*Izvest. Akad. Nauk Estonian S.S.R.* 4, 2(1955)) a formula for T_s is derived, which is then checked experimentally for NaCl with 0.001 and 0.3 mole % AgCl. W. Jacobson

LUSHCHIK, CH. B.

Category : USSR/Optics - Physical optics K-5

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 2378

Author : Lushchik, Ch.B.
Inst : Institute of Physics and Astronomy of the Acad. of Sciences Estonian SSR
Title : Investigation of Capture Centers in Crystals by the Thermal-Discoloring Method

Orig Pub : Zh. eksperim. i teor. fiziki, 1956, 30, No 3, 488-500

Abstract : Presentation of the theory of a method for the investigation of capture centers in alkali halide crystals by thermal discoloring (TD), caused by thermal liberation of electrons (holes) from their localization centers. One measures for this purpose the temperature dependence of the absorption coefficient $\Delta\alpha_m$ at the maximum of the absorption bands of capture centers of a definite type, the crystal being uniformly heated. It is assumed that the capture centers are of exactly equal depth, that the TD has a bimolecular mecahnism, and that $\Delta\alpha_m$ is proportional to the concentration n of the capture centers. The TD method was used to investigate the capture centers in KCl exposed to X-rays and also in $KCl.CaCl_2$ and $KCl.SrCl_2$ (0.5 mol. % of Ca^2 or Sr^{2+}), excited with an aluminum spark. Two bands are observed in the KCl absorption spectrum, at 555 mμ (F-centers) and 225 mμ (V-centers). $KCl.CaCl_2$ produces bands at 580, 350, and 225 mμ, while $KCl.SrCl_2$ produces bands at 590, 350, and 225 mμ. The bands at 580 and 590 mμ correspond to Z centers, while those at 350 mμ are attributed

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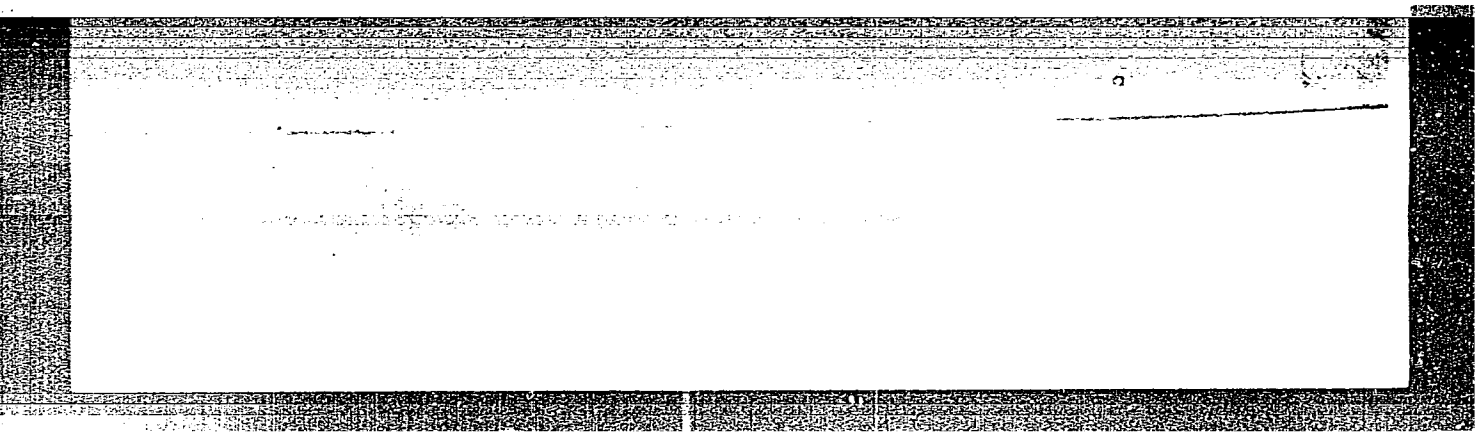
Category : USSR/Optics - Physical optics

K-5

Abs Jour : Ref Zhur - Fizika, No 1, 1957 No 2378

by Seitz to V_1 centers. It was established that the shape of the curves $\Delta\alpha_m$ (T) is independent of the initial value n_0. This is evidence of low probability of repeated captures of electrons by the color centers. The energy of the optical and thermal dissociation of the capture centers (E_λ and E_T) depends on the type of impurity. For KCl, E_λ = 2.22 ev and E_T = 0.97--1.02 ev. For KCl.$CaCl_2$, E_λ = 2.12 ev and E_T = 0.85--0.86 ev, while for KCl.$SrCl_2$, E_λ = 2.08 ev and E_T = 0.80 ev. The author concludes that thermal glow involves the liberation of electrons rather than holes.

Card : 2/2



LUSHCHIK, G.; LUSHCHIK, CH.

"On a model of centers of luminescence in alkali halide crystallophosphors."

p. 5 (UURIMUSED. TRUDY) No. 6, 1957
Tartu, Estonia

SO: Monthly Index of East European Accessions (EEAI) LC. Vol. 7, no. 4, April 1958

LUSHCHIK, CH. and others

"Problem of migration of energy in alkali halide crystallophosphor."

p. 63 (Uurimused. Trudy) No. 6, 1957
Tartu, Estonia

SO: Monthly Index of East European Accessions (EEAI) LC. Vol. 7, no. 4, April 1958

Lushchik, Ch.B.

48-4-8/48

SUBJECT: USSR/Luminescence

AUTHOR: Lushchik Ch.B.

TITLE: New Methods for Investigations of Relaxation Processes and Capture Centers in Crystallophosphors (Novyye metody issledovaniya relaksatsionnykh protsessov i tsentrov zakhvata v kristallofosforakh)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1957, Vol 21, #4, p 504 (USSR)

ABSTRACT: The following new methods for investigations of relaxation processes are considered:

1. The thermal decolorization method,
2. The thermo-optical de-luminescence method,
3. A version of the Bull and Mason Method,
4. A method based on measuring dependence of "negative excitation absorption" on temperature of heating a phosphor.

Applications of these methods for solution of various problems are mentioned.

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48-4-8/48

TITLE: New Methods for Investigations of Relaxation Processes and Capture Centers in Crystallophosphors (Novyye metody issledovaniya relaksatsionnykh protsessov i tsentrov zakhvata v kristallofosforakh)

Direct investigation methods of distribution of electrons and holes by capture levels during relaxation processes are also considered.

No other references are cited.

INSTITUTION: Institute of Physics and Astronomy of the Estonian Academy of Sciences.

PRESENTED BY:

SUBMITTED: No date indicated

AVAILABLE: At the Library of Congress.

Card 2/2

LUSHCHIK CH. B.

48-5-27/56

SUBJECT: USSR/Luminescence

AUTHORS: Lushchik, Ch.B., Zaitov, F.N., Kark, V.Ya., Teyss, L.A. and Yaek, I.V.

TITLE: Investigation of Capture Centers and Kinetics of Relaxation Processes in Alkali-Haloid Crystallophosphors (Issledovaniye tsentrov zakhvata i kinetiki relaksatsionnykh protsessov v shchelochno-galoidnykh kristallofosforakh.)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1957, Vol 21, #5, pp 693-694 (USSR)

ABSTRACT: The role of capture centers of various types in recombinational luminescence of alkali-haloid crystallophosphors was studied by several methods.
Capture centers of a basis substance (F, F', M, O, P, etc) and capture centers created by bi-valence admixtures Ca^{2+} and Sr^{2+} are manifested in thermal de-luminescence and optical flash. The number and main characteristics of these centers can be considerably changed by means of plastic deformation and temperature treatment.
The effect of several activators (Ag^{+}, Cu^{+}, Tl^{+}, Pb^{2+} and Mn^{2+}) on the spectrum of excited absorption, thermal de-luminescence and thermal decolorization of phosphors based on NaCl and KCl

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TITLE: Investigation of Capture Centers and Kinetics of Relaxation Processes in Alkali-Haloid Crystallophosphors (Issledovaniye tsentrov zakhvata i kinetiki relaksatsionnykh protsessov v shchelochno-galoidnykh kristallofosforakh.)

was investigated. Especially many electrons are stored in phosphors with two activators (e.g., NaCl-Ca^{2+}, Ag^{+}). Activator capture centers are also manifested in recombinational luminescence, but their existence is often disguised by temperature quenching.

The distribution of electrons and holes over capture levels essentially changes during the processes of decay and flash.

This distribution, which is established in the result of a lasting excitation by X-rays, is not a temperature equilibrium one. The degree of filling capture levels by electrons can be as high as 30 %, but is not complete. The report was followed by a discussion. One Russian reference is cited.

INSTITUTION: Institute of Physics and Astronomy of the Estonian Academy of Sciences and Tartu State University.

PRESENTED BY:

SUBMITTED: No date indicated.

AVAILABLE: At the Library of Congress.

Card 2/2

65971

SOV/58-59-4-9433

24.7700

Translation from: Referativnyy Zhurnal Fizika, 1959, Nr 4, p 288 (USSR)

AUTHORS: Lushchik, Ch.B., Liyd'ya, G.G.

TITLE: Exciton Capture Centers in Alkali Halide Crystals Activated by Mercury-Like Ions

PERIODICAL: Tr. In-ta fiz. i astron., AS EstSSR, 1958, Nr 7, pp 193 - 226 (Eng. résumé)

ABSTRACT: The authors investigated the changes that arise in the absorption and in the excitation spectra of KBr crystals activated by mercury-like ions (Ga^{+}, In^{+}, Tl^{+}, Ge^{2+}, Sn^{2+}, and Rb^{2+}) after X-ray irradiation and illumination by ultraviolet radiation in the region of activator and exciton absorption bands. On the basis of the obtained results and the data in the literature the authors examine the interaction of excitons with impurity and intrinsic crystal microdefects serving as "exciton dissociation centers" and "exciton annihilation centers". The former may be divalent impurity ions, e.g. $M^{2+} + ex \rightarrow M^{2+} ex \rightarrow M^{2+} e + p$ with subsequent hole localization in the cation vacancy (this was demonstrated experimentally for KBr-Pb, KBr-Ge, and KBr-Mn), while the latter may be

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Exciton Capture Centers in Alkali Halide Crystals Activated by Mercury-Like Ions

monovalent impurity ions, e.g. $M^+ + ex \rightarrow M^+ ex \rightarrow M^{+*} \rightarrow M^+ + h\nu$ (M is the impurity ion, ex is the exciton, e is the electron, and p is the hole). The phenomenon of the de-exciting action of X-rays was investigated in NaCl-Pb, KBr-Tl, and KCl phosphors. The authors discuss the exciton mechanism of this phenomenon. The de-exciting action of excitons in KBr-Pb is experimentally confirmed. A study of the optical decoloration spectrum of the F centers in KCl-Ca, Ag showed that the F centers become decolorized not only in the F and V absorption bands but also in other electron absorption bands. The bibliography contains 84 titles.

G.G. Liyd'ya

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24(2), 24(7) SOV/48-22-11-16/53

AUTHORS: Lushchik, Ch. B., Lushchik, N. Ye.

TITLE: Spectroscopy of Luminescence Centers in Alkali-Halide Crystal Phosphors Activated With Mercury-Type Ions (Spektroskopiya tsentrov lyuminestsentsii v shchelochno-galoidnykh kristallofosforakh, aktivirovannykh rtutepodobnymi ionami)

PERIODICAL: Izvestiya Akademii nauk SSSR, Seriya fizicheskaya, 1958, Vol 22, Nr 11, pp 1351-1355 (USSR)

ABSTRACT: The structure of electron absorption spectra (excitation spectra) exhibits the same basic features in all kinds of phosphors: A wide (sometimes split) band and a group consisting of three weaker long-wave bands. A quantitative comparison of the characteristics of free ions and of the luminescence centers demonstrated, however, that the properties of the "mercury-type ions" are modified by the intramolecular field to a much greater degree than those of the rare-earth ions. Such ions are Ga^{+}-, Ge^{2+}-, In^{+}-, Sn^{+}-, Tl^{+}-, and Pb^{2+}-ions (Ref 18). For all metal impurities in alkali-halide crystals the "compression coefficient" $\varepsilon = E_g/E_k > 1$, that is to say the field of the

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crystal lattice causes an approximation of the energy levels of the impurity cation centers. For impurity anion centers an inverse regularity had to be expected: $\varrho < 1$. The mutual position of the energy levels of the electron configuration $^3P_0$, $^3P_1$, $^3P_2$, and $^1P_1$ is modified if an ion is introduced into the lattice field in a direction which indicates a weakening of the (L, S)-bond by the crystal lattice (Ref 5). It appeared that approximately $\varrho = 1 + aE_g'$ (Ref 5). This approximate relation permits to make some important, if only rough estimates. The intracrystalline field causes a splitting of the levels of mercury-type ions into three sublevels. The electron vibrational structure of the spectra has been investigated by Pekar and coworkers by exact methods and by means of series expansions (Refs 22-25). The elementary emission and absorption bands of the luminescence centers of phosphors which have been activated by mercury-type ions exhibit a shape approximating that of Gaussian error curve, which is due to the heavy energy losses in Stokes' fluorescence

Spectroscopy of Luminescence Centers in Alkali-Halide Crystal Phosphors Activated With Mercury-Type Ions

(1 - 2 eV). This was also predicted by the theory of Pekar (Ref 22) and can be concluded from the Klick model (Ref 16). The parameters of the potential curves of luminescence centers computed according to data provided by measurements at different temperatures demonstrated that l, Q, and E_e are dependent upon temperature, l being the quantum number, E_e the energy of a pure electron transition, and Q the activation energy of the temperature extinction of luminescence. The Klick-Williams model can be considered a good first order approximation of a description of the luminescence centers. This model can be successfully used in describing a number of important spectral regularities in a semi-quantitative manner. Quite recently a new physical phenomenon, that of an "optical extinction" in the impurity centers of the crystals was predicted on the basis of this model. Taking into account this effect criteria of the existence of luminescence and deviations from the Vavilov rule (Refs 32,3,33,8) were investigated. There are 2 figures and 33 references, 24 of which are Soviet.

SOV/48-22-11-16/33

Spectroscopy of Luminescence Centers in Alkali-Halide Crystal Phosphors Activated With Mercury-Type Ions

ASSOCIATION: Institut fiziki i astronomii Akademii nauk EstSSR (Institute of Physics and Astronomy, AS Estonian SSR)

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Lushchik, Ch. B.

24(4) PHASE I BOOK EXPLOITATION SOV/3140

Akademiya nauk Ukrainskoy SSR. Institut fiziki

Fotoelektricheskiye i opticheskiye yavleniya v poluprovodnikakh; trudy pervogo vsesoyuznogo soveshchaniya po fotoelektricheskim i opticheskim yavleniyam v poluprovodnikakh, g. Kiyev, 20-26 noyabrya 1957 g (Photoelectric and Optical Phenomena in Semiconductors; Transactions of the First Conference on Photoelectric and Optical Phenomena in Semiconductors...) Kiyev, 1959. 403 p. 4,000 copies printed.

Additional Sponsoring Agency: Akademiya nauk SSSR. Prezidium. Komissiya po poluprovodnikam.

Ed. of Publishing House: I. V. Kisina; Tech. Ed.: A. A. Matveychuk; Resp. Ed.: V. Ye. Lashkarev, Academician, Ukrainian SSR, Academy of Sciences.

PURPOSE: This book is intended for scientists in the field of semiconductor physics, solid state spectroscopy, and semiconductor devices. The collection will be useful to advanced students in universities and institutes of higher technical training specializing in the physics and technical application of semiconductors.

COVERAGE: The collection contains reports and information bulletins (the latter are indicated by asterisks) read at the First All-Union Conference on Optical and Photoelectric Phenomena in Semiconductors. A wide scope of problems in semiconductor physics and technology are considered: photoconductivity, photoelectromotive forces, optical properties, photoelectric cells and photoresistors, the actions of hard and corpuscular radiations, the properties of thin films and complex semiconductor systems, etc. The materials were prepared for publication by E. I. Rashboy, O. V. Snitko, K. B. Tolpygo, A. F. Lubchenko, and M. K. Sheynkman. References and discussion follow each article.

Photoelectric and Optical Phenomena (Cont.) SOV/3140

Photoelectric and Optical Phenomena (Cont.) SOV/3140

SOV/51-6-1-28/30

AUTHORS: Lushchik, Ch.B. and Moskvin, A.V.

TITLE: VII Conference on Luminescence (Crystal Phosphors). (VII Soveshchaniye po lyuminestsentsii (kristallofosfory))

PERIODICAL: Optika i Spektroskopiya, 1959, Vol 6, Nr 1, pp 122-124 (USSR)

ABSTRACT: The VII Conference on Luminescence was held in Moscow between June 26 and July 3, 1958. It was organized by the Physics Institute imeni P.N. Lebedev of the Academy of Sciences of the U.S.S.R. and by the Scientific Council on Luminescence. The conference was devoted to the physics, chemistry and applications of crystal phosphors. Over 350 delegates from 24 cities and towns in the Soviet Union attended the conference. Hungarian, Polish and East German scientists were also present. Over 100 papers were read at 4 plenary and 14 sectional sessions. The conference was split into two parallel sections on the physics and on the chemistry of crystal phosphors. Papers on the physics of crystal phosphors could be divided into the following groups: (1) nature of the luminescence centres, (2) processes of transfer of energy in crystals, (3) kinetics of recombination luminescence and the nature of capture centres, (4) physical processes occurring on excitation with electric fields, electron beams and hard radiations.

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VII Conference on Luminescence (Crystal Phosphors).

The authors review first the papers on the nature of luminescence centres. These papers included work on quantum-mechanical calculation of a luminescence centre in KCl-Tl (N.N. Kristofel'), a discussion of alkali-halide phosphors activated with mercury-like ions (N.Ya.Lushchik, work on halide phosphors in which the activator ions were said to be distributed along crystal lattice sites (F.D. Klement), a discussion of surface effects in luminescence (P. Shvist and N.I. Ivanova), a paper on crystals in which luminescence centres are in the form of complexes situated on the surface (I.M. Shamovskiy and A.A. Dunina). Z.A. Trapeznikova, M.L. Kats and N.Ya.Lushchik showed that in phosphors with one activator several types of luminescence centres are possible. The effects of uniform pressure of 7000 atm on luminescent properties of Zn_2SiO_4-Mn and of halide phosphors were reported by Ya.Ya. Kirs. Z.L. Morgenshtern reported work on luminescence of non-activated alkali-halide crystals. The temperature quenching of luminescence of alkali-halide phosphors and the relationship between optical and thermal properties of impurity centres were reported in a paper by K.K. Shvarts. I.K. Plyavin' showed that the short-duration emission of alkali-halide phosphors is of metastable nature. A number of papers

VII Conference on Luminescence (Crystal Phosphors)

dealt with capture centres in alkali-halide phosphors (I.A. Parfianovich, F.K. Zaitov, L.Ya. Uybo, P.A. Khellenurme, A.Kh. Khalilov, A.M. Polonskiy and others). Ch.B. Lushchik and G.G. Liyd'ya reported investigations of the interaction of excitons with various defects of the crystal lattice. Mechanisms of electron and hole processes producing recombination luminescence in alkali-halide phosphors were discussed in papers by M.L. Kats, I.A. Parfianovich, L.M. Shamovskiy, Ch.B. Lushchik, Kh.F. Kyaembra and I.V. Yaek. A group of papers dealt with kinetics of recombination luminescence and interpretation of relaxation relationships in terms of the band theory of phosphors (N.A. Tolstoy, A.A. Ryskin, M.V. Fok, F.I. Vergunas, K.K. Rebane, Yu.M. Popov). Flash emission by ZnS phosphors was reported by N.A. Tolstoy and his co-workers. The effect of infrared radiation on recombination luminescence was discussed in papers by P.P. Jaszczyn (Poland) and K.S.K. Rebane. V.L. Levshin and B.M. Orlov studied thermo-optical maximum of electron liberation from capture levels. In papers and discussions at the Conference it was stressed that studies of recombination luminescence kinetics should include not only electron and electron-hole processes, but also exciton, sensitizing, ionic, dislocation and electron-vibrational processes. Only a small number of papers dealt with luminescent and electrical properties of phosphors (O.V. Agashkin, I.K. Vitol, Ya.A. Oksman, [illegible],

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VII Conference on Luminescence (Crystal Phosphors)

P.Ye. Ramazanov). Professor Nad' (Nagy) of Hungary, V.V. Antonov-Romanovskiy, M.V. Fok and others discussed the mechanism and kinetics of electroluminescence. V.Ye. Oranovskiy and B.T. Fedyushin reported their investigations of anisotropy of electroluminescence in synthetic ZnS crystals. V.Ye. Oranovskiy and Z A. Trapeznikova read a paper on sulphides activated with rare earths in which they established the identity of emission centres responsible for photoluminescence and electroluminescence. Practical applications of electroluminescence were dealt with in the papers of N.N. Orlov and I.Ya. Lyamichev. Papers on cathodoluminescence of crystals included one by M.D. Galanin and A.V. Rayevskiy on temperature quenching of luminescence of ZnS-Ag excited with α-particles. The papers on the chemistry of crystal phosphors dealt with a great variety of subjects. Many of them described preparation of new photo-phosphors (Yu.M. Lecnov and F.M. Pekerman), cathodo-phosphors (M.[illegible] Kh.S. [illegible] N.A. Gorbacheva, B.M. Gugel', L.Ya. Markovskiy and V.F. Nazarova) and electro-phosphors (T.K. Voznesenskaya, O.M. Kazankin and Z.I. Klabukova). Luminescence of oxides (M.A. Konstantinova-Shlezinger), observations on behaviour of europium in silicates and phosphates (Yu.S. Blank and V.P. Nazarova), relationship between temperature quenching and stability

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of crystal lattice of tungstates (Yu.M. Leonov) and ageing in cathodoluminescence (B.M. Gugel') were also reported. Interaction of "blue" and "samarium" centres in sulphide phosphors activated with rare-earth ions was reported in a paper by Z.A. Trapeznikova. Excess zinc and silver as activators of sulphides were discussed by A.A. Bundel' and A.A. Cherepnev. The effect of oxygen in formation of luminescence centres was dealt with by A.A. Bundel', A.M. Gurevich and Yu.M. Leonov. Existence of a new crystal phase in the wurtzite-sphalerite system was discovered by S.A. Fridman who also reported work on rare-earth activators. Preparation of sulphide monocrystals was described by Ye.I. Panasyuk. Phase analysis of willemite was reported by V.V. Osiko. Many papers dealt with phosphors prepared by sublimation and with luminescent screens. Extension of the range of activators and bases used to prepare screens by sublimation was also reported. Practical applications of such screens were dealt with by E.Ya. Arapova, Ye.I. Blazhnova, N.A. Vlasenko and V.V. Golubeva. There were only a few papers on the

industrial processes of preparation of phosphors and on purification methods. Application of luminescence to the study of phase equilibria (V.V. Osiko) and to the study of reactions in the silicate phase (A.K. Trofimov and Yu.M. Leonov) were also reported. The authors of the report point out that the Conference showed lack of coordination of studies of phosphors and semiconductors and some examples of lag of theory behind experiments and vice versa.

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SOV/23-59-4-6/10

AUTHOR: Lushchik, Ch.B., Candidate of Physico-Mathematical ~~Sciences~~

TITLE: The Mechanism of the Luminescence of Alkali-Halide Crystals Activated by Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+}, Pb^{++}

PERIODICAL: Izvestiya Akademii nauk Estonskoy SSR, Seriya tekhnicheskikh i fiziko-matematicheskikh nauk, 1959, Vol 8, Nr 4, pp 287 - 295 (USSR)

ABSTRACT: The author discusses the nature of the centers of luminescence and the mechanism of the processes of transferring energy from the basic substance to the centers of luminescence in activated alkali-halide crystals. The present report was submitted to the III Vsesoyuznoye soveshchaniye po teorii poluprovodnikov (Third All-Union Conference on the Theory of Semiconductors) in L'vov on 7 April 1959, and to the Mezhdunarodnaya konferentsiya po fizike i khimii kristallofosforov (International Conference on the Physics and Chemistry of Crystal Phosphorus) in

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The Mechanism of the Luminescence of Alkali-Halide Crystals Activated by Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+}, Pb^{++}

Greifswald (GDR), on 28 April 1959. The author refers to the classical investigation of alkali-halide crystals activated by thallium [Ref 1] at the Pohl School in Göttingen. The results obtained were generalized in the well known work of F. Seitz [Ref 2]. Later on, the ideas of F. Seitz on the mechanism of luminescence of activated alkali-halide phosphorus were subjected to an experimental check and theoretical processing in many written works [Ref 3 - 9]. Principally, alkali-halide crystals activated by thallium were examined. Crystals with an admixture of lead [Ref 2 and 10] and tin [Ref 10 - 13] were studied less fully. During 1955 to 1957 N. Ye. Lushchik synthesized a number of alkali-halide monocrystals activated by indium, gallium and germanium [Ref 14, 15]. This made it possible to examine "binary homologous series" of crystal phosphorus on the basis of KCl,

The Mechanism of the Luminescence of Alkali-Halide Crystals Activated by Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+}, Pb^{++}

KBr, KI, NaCl, activated by 6 ions-analogous of the mercury atom: Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+}, Pb^{++}. The author and his collaborators (F.N. Zaitov, V.Ya. Kark, Kh.F. Kyaembre, G.G. Liyd'ya, N.Ye. Lushchik, E.S. Tiysler, K.K. Shvarts and I.V. Yaek) carried out a comprehensive study of the alkali-halide crystals activated by all these "mercury-like" ions [Ref 14 - 27]. On the basis of these results and the literary data, it is possible to examine the problem of mechanism of luminescence of phosphorus of this class in more detail than 20 years ago. As a result of his studies of alkali-halide crystals activated by mercury-like ions, the author comes to the conclusion that they are typical crystal phosphorus. The processes causing their luminescence cannot be reduced to electronic-oscillatory processes within the centers of lumi-

 nescence. The crystal lattice of the basic sub-

The Mechanism of the Luminescence of Alkali-Halide Crystals Activated by Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+}, Pb^{++}

stance does not only serve as a disturbing medium and thermostat, but also as a medium that accumulates and transfers the excitation energy. The mechanism of luminescence of activated alkali-halide phosphorus is complicated and when examining it, it is necessary to take into consideration the active part of the electron, hole type, exciton and sensitizing processes as well as the complicated "chemistry" of the point, linear and surface defects of the crystal lattice. There are 6 graphs and 52 references, 40 of which are Soviet, 8 English and 4 German.

ASSOCIATION: Institut fiziki i astronomii Akademii nauk Estonskoy SSR (Institute of Physics and Astronomy, Academy of Sciences of the Estonskaya SSR)

SUBMITTED: May 12, 1959

LUSHCHIK, Ch. B., YAEK, I. V., LUDIYA, G. G., LUSHCHIK, N. Ye., and SHVARTS, K. K.

Physical Processes in Alkali Halide Phosphors Activated by Mercury-Like Ions

Ch. B. Lushchik, I. W. Jack, G. G. Lŭdja, N. E. Lushchik, and K. K. Schwarz
Physics and Astronomy Institute, Academy of Sciences of the Estonian S.S.R., Tartu, U.S.S.R.

A number of alkali halide phosphors activated by monovalent and divalent ions having the electronic configuration of neutral mercury were prepared. Diffusion and precipitation of activator ions were investigated as were absorption, emission, and radiationless processes within the impurity center. Energy transfer by means of excitons and electron-hole pairs between the luminescent center, the host crystal and color centers were also studied.

Report presented at the 117th Meeting of the Electrochemical Society, Chicago, 1-5 May 1960.

LUSHCHIK, Ch. B., LUEDYA, G. G., and YAEK, I. V.

"The Mechanism of Formation of Color Centers in Ionic Crystals by Ultraviolet Irradiation."

report presented at the International Conference on Semiconductor Physics, Prague, Czechoslovakia, 28 Aug 1960.

authors all of the
University of Tartu

21019

S/058/61/000/005/027/050
A001/A101

24.3500 (1137, 1138, 1147)

AUTHORS: Lushchik, Ch.B., Tiysler, E.S.

TITLE: A spectrophotometric investigation of delocalization of excitations in ionic crystals

PERIODICAL: Referativnyy zhurnal. Fizika, no 5, 1961, 182, abstract 5V387 ("Tr. In-ta fiz. i astron. AN EstSSR", 1960, no 12, 125 - 148, Engl. summary)

TEXT: The authors investigated changes in absorption spectra of alkali halide crystals activated by mercury-like ions, caused by the action of ultraviolet radiation which was absorbed by luminescence centers. They consider possible processes of delocalization of excitations in ionic crystals. There are 42 references.

[Abstracter's note: Complete translation.]

Card 1/1

23335 S/058/61/000/006/021/063
A001/A101

24.3500(1137,1138,1395)

AUTHORS: Lushchik, Ch.B., Uybo, L.Ya.

TITLE: Exciton, electron and hole processes in ammonium-halide crystalline phosphors

PERIODICAL: Referativnyy zhurnal. Fizika, no. 6, 1961, 177, abstract 6V320 ("Tr. In-ta fiz. i astron. AN EstSSR", 1960, no. 12, 275 - 277)

TEXT: The following conclusions were drawn from investigations of electron, hole, exciton and other processes in alkali-halide (I) and ammonium-halide (II) crystals, carried out in Tartu during a number of years: 1) optical characteristics of excitons in I and II are similar, exciton processes in them proceed in a like manner; 2) optical characteristics of electron color centers in I and II differ sharply, whereas optical and thermal characteristics of hole color centers in I and II are similar; 3) hole processes taking place in low-temperature (100-300° K) thermoluminescence differ slightly. Comparing the regularities obtained the authors conclude that physical phenomena affecting the anion sublattice of crystals are very similar in I and II; but processes occurring, according to modern notions, in the cation sublattice of the mentioned crystals are essentially different.
[Abstracter's note: Complete translation]

N. Maksimova

Card 1/1

68332

24,3500

AUTHORS: Kark, V. Ya., Lushchik, Ch.B. and Yaek, I.V. 507/51-8-1-33/40

TITLE: On Sensitized Phosphorescence of Halide Phosphor Crystals

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 1, pp 144-146 (USSR)

ABSTRACT: The paper deals with sensitized phosphorescence of activated alkali halide crystals. The mechanism of this phosphorescence differs radically from sensitized phosphorescence of organic molecules (Ref 11) and from sensitized luminescence of ZnS phosphors due to migration of holes. The authors investigated the excitation spectra of phosphorescence (the technique was described earlier, Ref 13) of KBr:Tl,In. It was found that recombination luminescence of Tl^+ ions is excited on absorption in the thallium absorption bands and phosphorescence of indium on absorption in the indium absorption bands. The phosphor seems to "remember" the nature of excitation. Sensitized phosphorescence did not occur in KBr:Tl,In. Following a suggestion by one of us, Shvarts and Zirnits investigated sensitized fluorescence of several poly-activated phosphors (Ref 14). In agreement with the data reported by American workers (Ref 15), a transfer of energy between Pb^{++} and Mn^{++} was observed in NaCl:Pb,Mn and KCl:Pb,Mn phosphors. Shvarts and Zirnits found also transfer of energy from Tl^+ and In^+ ions to Mn^{++} ions in NaCl:Tl,Mn and NaCl:In,Mn phosphors. Malyshev found similar

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On Sensitized Phosphorescence of Halide Phosphor Crystals

behaviour in $CdBr_2$:Pb,Mn and CdI_2:Pb,Mn systems (Ref 16). The present authors attempted to find sensitized phosphorescence in systems in which sensitized fluorescence was observed earlier, e.g. $CdBr_2$:Pb,Mn which exhibits strong recombination luminescence (Ref 3). A figure on p 145 shows the excitation spectra of phosphorescence of Pb^{++} (curve 1) and Mn^{++} ions (curve 2) of the latter phosphor. The spectra are identical and they correspond to the activator absorption by lead (transitions $^1S_0 \rightarrow {}^1P_1$ and $^1S_0 \rightarrow {}^3P_1$ transitions in Pb^{++} ions). At 293°K phosphorescence of Mn^{++} ions was observed many seconds after excitation in the absorption bands of Pb^{++} ions ($^1S_0 \rightarrow {}^3P_1$ transition); this is, of course, sensitized phosphorescence of $CdBr^2$:Pb,Mn. The figure also includes the luminescence spectrum of $CdBr_2$:Pb,Mn (curve 3) excited in the absorption band at 3.9 eV, the latter corresponding to the electron transition $^1S_0 \rightarrow {}^3P_1$ in Pb^{++} ions. Two bands appear in luminescence, one of which was observed also in $CdBr_2$:Pb and corresponds to the transition $^3P_1 \rightarrow {}^1S_0$ in Pb^{++} ions. The second band in curve 3 (at longer wavelengths) appears after introduction of manganese into $CdBr_2$:Pb

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On Sensitized Phosphorescence of Halide Phosphor Crystals

and corresponds to transitions ^4G--^6S in Mn^{++} ions. The figure on p 145 includes also a qualitative phosphorescence spectrum of $CdBr_2$:Pb,Mn (curve 4), obtained after excitation in the 3.9 eV band. The similarity of the spectra at the moment of excitation and of subsequent phosphorescence indicates resonance energy transfer to Mn^{++} ions after excitation of Pb^{++} ions and as a result of intermediate recombination processes. There are 1 figure and 17 references, 15 of which are Soviet and 2 English.

SUBMITTED: June 10, 1959

Card 3/3

S/051/60/008/02/036/036
E201/E391

AUTHOR: Lushchik, Ch.B.

TITLE: Conference on Physics of Alkali-halide Crystals

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 2, pp 283 - 284 (USSR)

ABSTRACT: A conference on physics of alkali-halide crystals was held in Tartu on June 30 - July 4, 1959. The conference was convened by the Nauchnyy sovet po lyuminestsentsii (Scientific Council on Luminescence), by the AN Estonskoy SSR (Ac.Sc., Estonian SSR) and by the Tartuskiy gosudarstvennyy universitet (Tartu State University). Over 100 delegates from thirteen cities of the Soviet Union heard 36 papers presented at eight sessions. In the opening and closing addresses, M.D. Galanin (Moscow) and F.D. Klement (Tartu) discussed the main physical properties of alkali-halides. A large number of papers dealt with luminescence.
I.A. Parfianovich (Irkutsk) reported on optical flash in crystals with non-uniform distributions of colour centres. M.L. Kats (Saratov) discussed changes in the absorption spectra of crystals produced by ionizing radiations. Ch.B. Lushchik, I.V. Yaek, G.G. Liyd'ya and E.S. Tiysler

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Conference on Physics of Alkali-halide Crystals

(Tartu) dealt with the mechanisms of electron, hole, exciton and sensitization processes in luminescence of activated alkali halides.
Luminescence of NaCl-Ni was discussed by Ye.I. Shuraleva (Irkutsk).
I.V. Yaek (Tartu) reported data on the excitation spectra of recombination luminescence and the "spectra of colour-centre formation".
Interaction of excitons with lattice defects was dealt with by G.G. Liyd'ya (Tartu).
Z.L. Morgenshtern (Moscow) reported her results on luminescence of non-activated CsI crystals.
Another group of papers dealt with theoretical and experimental aspects of luminescence centres in alkali halides.
M.I. Petrashen' (Leningrad) reported quantum-mechanical calculations of the optical properties of impurity centres in crystals.
N.N. Kristofel' (Tartu) and I.V. Abarenkov (Leningrad)

Conference on Physics of Alkali-halide Crystals

reported quantum-mechanical calculation of the adiabatic potentials and spectral characteristics of certain special types of impurity centres, such as luminescence centres in KCl-Tl and F-centres. Spectroscopy of luminescence in crystals activated with various impurity ions was discussed in a paper by N. Ye. Lushchik and Ch.B. Lushchik (Tartu). K.K. Shvarts (Riga) discussed thermal, optical and migration quenching of luminescence in crystals with mercury-light activators.

I.K. Plyavin' (Riga) reported results on the temperature dependence of the duration of photo-scintillations, this dependence being related to metastable energy levels in luminescence centres.

Ya. Ya. Kirs and A.I. Laysaar (Tartu) discussed the effect of hydrostatic pressure on the spectral characteristics of centres. A very promising method of investigation of the anisotropy of centres, using uni-directional compression of crystals, was reported by A.A. Kaplanskiy (Leningrad). T.A. Abdusadykov (Alma-Ata) and A.F. Malysheva (Tartu) discussed spectral properties of alkali-halide and

Conference on Physics of Alkali-halide Crystals

alkaline-earth-halide phosphors with large amounts of activators and other lattice defects. In several papers the nature of the colour centres in alkali-halide crystals was discussed.

A.A. Shatalov (Kiyev) reported his results on the photochemical and thermal transformations of colour centres in heated crystals.

Anisotropy of colour centres was dealt with by O.A. Shmit (Riga).

A.Kh. Khalilov and his co-workers (Baku) reported their results of an investigation of capture centres in alkali-halide crystals containing various impurity ions.

I.K. Vitol, Ch.B. Lushchik, I.V. Yaek and M.A. Elango (Tartu and Riga) dealt with non-isothermal relaxation processes in alkali-halide crystals.

Thermal ionization of F-centres was discussed in detail by L.M. Shamovskiy (Moscow).

A special session of the conference was devoted to dislocations and their effects.

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M.V. Klassen-Neklyudova and her co-workers (Moscow) discussed mechanical properties of pure alkali-halide crystals and their relationship with the presence and motion of dislocations.
The effect of impurities on "etch-figures" in KI crystals was dealt with in a paper by L.M. Shamovskiy and A.S. Shibanov (Moscow).
R.I. Gindina (Tartu) reported "decoration" of dislocations with non-isomorphic impurities and the relationship of "decoration" with luminescence.
A.A. Shatalov (Kiyev) discussed visualization of crystal-lattice defects by additive coloration.
Physico-chemical properties of alkali halides were dealt with in papers of the Tomsk school of physicists.
A.A. Vorob'yev and his co-workers (Tomsk) established a relationship between composition of solid solutions, such as NaCl-KCl, KCl-KBr, etc. and their physico-chemical properties.
Ye.K. Zavadovskaya, M.S. Ivankina, I.Ya. Melik-Gaykazyan and M.N.Treskina (Tomsk) discussed the effect of decomposition

Conference on Physics of Alkali-halide Crystals

of solid solutions of alkali halides on their physico-chemical properties.

Some new results on the structure of alkali-halide phosphors, obtained by X-ray diffraction methods, were reported by A.Ya. Pae and A.A. Khaav (Tartu).

Spectrophotometric investigation of diffusion of impurities in crystals was discussed by O.G. Mankin and N. Ye. Lushchik (Tartu).

In a long paper L.M. Belyayev and his co-workers (Moscow) dealt with preparation of activated LiF crystals and their luminescence. Interesting papers were presented on electrical properties of alkali halides.

A.N. Arsen'yeva-Geyl' (Leningrad) discussed external photo-effect in alkali-halide crystals with F-centres.

I.K. Vitol (Riga) reported results of investigations of the photoelectric properties of alkali halides with defect-gradient layers using a "dynamic capacitor" method.

In an extensive paper, A.A. Vorob'yev and his co-workers (Tomsk) discussed their results on electrical breakdown of alkali halides. Second conference to be held on physics of alkali-halide crystals in summer of 1961 in Riga.

Card6/6

S/051/60/008/06/015/024
E201/E691

24.3500

AUTHORS: Lushchik, N.Ye. and Lushchik, Ch.B.

TITLE: Spectroscopy of the Luminescence Centres in Alkali-Halide Crystals Activated with Homologous Series of Ions

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 6, pp 839-846 (USSR)

ABSTRACT: This paper was first presented at the Conference on Physics of Alkali-Halide Crystals held in Tartu in June 1959. In alkali-halide crystals activated with mercury-like (Ga^+, Ge^{++}, In^+, Sn^{++}, Tl^+, Pb^{++}) and other ions one is dealing with "direct activation" when the luminescence centres retain many characteristics of free ions. This was found to be true for NaCl, KCl, KBr and KI activated with the mercury-like ions listed above (series I, cf. Fig 1), as well as for two other homologous series: Cu^+, Ag^+, Au^+ (series II, cf. Fig 3), and Ca^+, Sr^+, Ba^+, Zn^+, Cd^+ (series III, cf. Fig 4). Quantitative analysis of the results (Fig 2) showed that the "compression" coefficient ϱ (the ratio of the energy of transition in a free ion, E_f, to the energy of the corresponding absorption band maximum, E_l, of the same ion acting as a luminescence centre in a crystal) rises linearly on

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E201/E691

Spectroscopy of the Luminescence Centres in Alkali-Halide Crystals Activated with Homologous Series of Ions

increase of E_f:

$$\varrho = E_f/E_l = 1 + aE_f \qquad (1)$$

Estimates obtained using Eq (1) showed that "direct activation" of alkali-halide crystals with other homologous series of ions is also possible, at least in principle. A promising line of investigation is "direct activation" of alkali halides with Sc^{+}, Ti^{++}, V^{+}, Zr^{++}, La^{++} and Hf^{++}, which differ from mercury-like ions by the absence of a filled d-shell. There are 4 figures and 30 references, 19 of which are Soviet, 9 English and 2 German.

SUBMITTED: September 28, 1959

Card 2/2

Lushchik, Ch.B.

81917

24.3500

S/051/60/009/01/012/031
E201/E691

AUTHORS: Lushchik, Ch.B., Liyd'ya, G.G., Yaek, I.V. and Tiysler, E.S.

TITLE: The Mechanism of the Recombination Luminescence[21] of Activated Alkali-Halide Crystals

PERIODICAL: Optika i spektroskopiya, 1960, Vol 9, Nr 1, pp 70-78 (USSR)

ABSTRACT: This paper was presented in an expanded version at the Conference on Physics of Alkali-Halide Crystals (Tartu, June 1959). The authors report and discuss the results of an investigation of the recombination luminescence (due to recombination of electrons and holes) and photochemical transitions (optical bleaching) in KCl, KBr and KI crystals activated with Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+} and Pb^{++}. The crystals were excited with X-rays and light in the regions of exciton and activator absorption bands and of the "band-band" transitions. The role of electron, hole, exciton and sensitization processes is discussed. The discussion is illustrated by excitation, luminescence, thermoluminescence, optical flash stimulation, optical and thermal bleaching spectra (Figs 1-5). There are 5 figures and 32 references, 30 of which are Soviet and 2 English.

Card 1/1

SUBMITTED: September 28, 1959

84673
S/051/60/009/002/011/013/XX
E201/E491

24.3600 2209, 1138, 1144

AUTHORS: Lushchik, Ch.B., Lushchik, N.Ye. and Shearts, K.K.

TITLE: Electronic-Vibrational Processes in Luminescence Centres of Ionic Crystals

PERIODICAL: Optika i spektroskopiya, 1960, Vol.9, No.2, pp.215-222

TEXT: The paper was first presented at the Eighth Conference on Luminescence held in October 1959 in Minsk.
The authors report a detailed study of electronic-vibrational processes in luminescence centres of alkali-halide crystals activated with Hg-like ions. The luminescence and absorption spectra were recorded and the luminescence quantum yield was found as a function of the exciting-light frequency ν_e and temperature. This was done for KCl-In, KBr-In, KCl-Ga, KBr-Ga, KCl-Tl, KBr-Tl, NaCl-Tl, KCl-Pb, KCl-Sn, KBr-Sn and other crystals. Some of the results are given in Figs.1 to 4. Fig.1 shows the luminescence spectra of NaCl-Tl at 550°K excited with 254 mμ (curve 1), 280 mμ (curve 2) and 289 mμ (curve 3). Fig.2 gives the absorption and luminescence spectra of NaCl-Tl (1), KCl-Tl (2), NaCl-Pb (3), KCl-Pb (4) and KBr-Pb (5). Fig.3 shows the energy diagrams of KCl and KBr crystals activated with Tl^+, Pb^{++}, In^+ and Sn^{++}. Fig.4 gives the quantum yields of luminescence of NaCl-Tl at

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Electronic-Vibrational Processes in Luminescence Centres of Ionic Crystals

580°K (1a) and KCl-Tl at 600°K (1b) as a function of the exciting-light frequency; curves 2 and 3 represent, respectively, the absorption and luminescence spectra of NaCl-Tl (a) and KCl-Tl (b). It was found that radiative and radiationless transitions occurred in luminescence centres after equilibrium was reached between the vibrational energy distribution in a crystal and the same distribution in excited centres. The quantum yield depended step-wise on ν_e: within individual electronic-vibrational absorption bands the yield was independent of ν_e, but it was different for different absorption bands. There are 4 figures, 1 table and 45 references: 35 Soviet, 9 English and 1 German.

SUBMITTED: November 30, 1959

Card 2/2

S/051/60/009/006/018/018
E201/E191

AUTHOR: Lushchik, Ch.B.

TITLE: International Conference on the Physics of Semiconductors

PERIODICAL: Optika i spektroskopiya, 1960, Vol.9, No.6, pp 797-798

TEXT: The International Conference on the Physics of Semiconductors was held on August 29 - September 2, 1960, in Prague. Over 500 scientists from Czechoslovakia, Hungary, Poland, Bulgaria, USSR, East Germany, West Germany, Britain, France, USA and Belgium, etc. took part. At the plenary session Academician A.F. Ioffe (USSR, deceased) spoke on "New approaches to semiconductor physics", and the Nobel Laureate W. Shockley (USA) dealt with "Problems connected with p-n junctions in silicon". Over 100 papers were presented at sectional sessions. The reviewer deals only with papers on ionic crystals and excitons. The Soviet contributions on these two subjects included: S.I. Pekar's paper on the theory of local electron centres in crystals; A.A. Shatalov's paper on photochemical transformations of colour centres in alkali-halide crystals;

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S/051/60/009/006/018/018
E201/E191

International Conference on the Physics of Semiconductors

a communication from Ch.B. Lushchik, G.G. Liyd'ya and I.V. Yaek on formation of colour centres in ionic crystals, including electronic, exciton and "delocalization" mechanisms of F-centre formation; and E.F. Gross's contribution on "Optical and magneto-optical effects in semiconductors".

There are no figures, tables or references.

Card 2/2

AUTHORS: Klement, F., Lushchik, Ch. S/053/60/070/04/008/0[illegible]
B006/B011

TITLE: Conference on the Physics of Alkali Halide Crystals

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol 70, Nr 4, pp 733-738 (USSR)

TEXT: This Conference was held at Tartu from June 30 to July 4, 1959; it had been convened by the Nauchnyy sovet po lyuminestsentsii pri Otdelenii fiziko- matematicheskikh nauk AN SSSR (Scientific Council for Luminescence at the Department of Physical and Mathematical Sciences of the AS USSR), the Akademiya nauk Estonskoy SSR (Academy of Sciences, Estonskaya SSR), and the Tartuskiy gosudarstvennyy universitet (Tartu State University). Alkali halide crystals constitute the classical investigation object of the properties of solids; basic research in this field has been made by A. F. Ioffe, V. D. Kuznetsov, and P. S. Tartakovskiy along with their students. The delegates at this Conference, totalling over 100 persons, represented the following institutes: Moscow: Fizicheskiy institut (Physics Institute), Institut kristallografii AN SSSR (Institute of Crystallography of the AS USSR), Vsesoyuznyy institut mineral'nogo syr'ya (All-Union Institute for Mineral Raw Materials) and others; Leningrad: Universitet (University), Elektrotekhnicheskiy institut (Institute of Electrical Engineering), and others; Tomsk: Politekhnicheskiy institut (Polytechnic Institute) Universitet (University); Khar'kov: Filial IREA (IREA Branch) and others; Kiyev: Universitet (University), Politekhnicheskiy inst.-

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tut (Polytechnic Institute), the Universities of Saratov, Irkutsk, and Riga, the Institut fiziki AN Latv.SSR (Physics Institute of the AS Latvian SSR) in Riga; Baku: Institut fiziki AN AzSSR (Physics Institute of the AS AzSSR); Minsk: Institut fiziki AN BSSR (Physics Institute of the AS BSSR); L'vov: Universitet (University); Alma-Ata: Pedagogicheskiy institut (Pedagogical Institute); Tartu: Institut fiziki i astronomii AN ESSR (Institute of the Physics of Astronomy of the AS ESSR) and University. Altogether 36 lectures were delivered. They were devoted to the following main subjects: 1) Local conditions in crystals; luminescence and color centers, 2) Electron-hole and exiton processes, 3) crystal structure, ionic and dislocation processes. The lecturers were: M. I. Petrashen' (Leningrad) on the quantum-mechanical calculation of certain optical properties of the impurity centers in crystals (the school of S. I. Pekar is mentioned), N. N. Kristofel' (Tartu) on the quantum-mechanical calculation of the adiabatic potentials and of the absorption and emission spectra of the luminescence centers in KCl-Tl, I. V. Abarenkov (Leningrad) on the calculation of the adiabatic potentials of the F-centers in point-lattice approximation, N. Ye. Lushchik and Ch. B. Lushchik on the spectroscopy of luminescence centers, K. K. Shvarts (Riga) on luminescence extinction processes, I. K. Plyavin' (Riga) on the kinetics of short-time luminescence, Ya. Ya. Kirs and A. I. Laysaar (Tartu) on the influence of a uniform pressure

(up to 6000 atm) on the excitation and emission spectra of alkali halide phosphors, T. A. Abdusadykov (Alma-Ata) on the spectral characteristics of the luminescence centers with high activator content in the crystal, A. F. Malysheva (Tartu) on the spectral characteristics of crystal phosphors activated with Tl^{+} and Pb^{++} (L. A. Rebane took part in the discussion), Z. L. Morgenshtern on the part played by various defects in ion crystals (P. P. Feofilov is mentioned), A. A. Kaplyanskiy (Leningrad) on a novel method of investigating the anisotropy of the centers in cubic crystals, O. A. Shmit (Riga) on the real and "induced" anisotropy of the centers, A. A. Shatalov (Kiyev) on photochemical and thermal transformations of "defect centers", L. M. Shamovskiy (Moscow) on the energy of thermal ionization of the F-centers in alkali halide crystals and A. Kh. Khalilov, E. Yu. Salayev, T. D. Aliyeva, A. P. Mamedov, and F. A. Isayev (Baku) on comprehensive investigations of the spectral characteristics of NaCl, KCl, and KBr. To the second main subject belonged the lectures delivered by A. N. Arsen'yeva-Geyl' (Leningrad) on the outer photoelectric effect on alkali halide crystals, Ch. B. Lushchik, G. G. Livdyo, I. V. Yaek, and E. S. Tiyslar (Tartu) on the part played by electron-hole and exiton processes in the luminescence of Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+}, and Pb^{++} ions, I. V. Yaek (Tartu) concerning photothermal processes leading to the recombination luminescence and electron color centers; V. V. Antonov-Romanovskiy on

his method of ionizing Eu^{++} in Sr-Eu phosphors by means of paramagnetic resonance, G. G. Liyd'ye (Tartu) on dislocation and annihilation of exitons in the interaction with crystal defects, M. L. Kats (Saratov) on the change in absorption spectra brought about by the action of ionizing radiation, Ye. I. Shuraleva (Irkutsk) on the luminescence of atomic centers in NaCl-Ni phosphors, I. A. Parfianovich (Irkutsk) on the mechanism of optical scintillation (P. A. Khellenurme took part in the discussion), I. K. Vitol, Ch. B. Lushchik, I. V. Yaek, and M. A. Elango (Riga, Tartu) on comprehensive investigations of relaxation processes with electric and magnetic methods (P. A. Yurachkovskiy took part in the discussion), and I. K. Vitol (Riga) spoke on the photoelectric properties of "defect-gradient" layers in alkali halide crystals. The following lectured on the third subject: M. V. Klassen-Neklyudova, G. V. Berezhkova, V. G. Goverkov, G. F. Dobrzhanskiy, V. L. Idenbom, V. G. Regel', G. Ye. Tomilovskiy, A. A. Urusovskaya, and M. A. Chernysheva (Moscow) on the mechanical properties of alkali halide crystals, L. M. Shamovskiy and A. S. Shibanov (Moscow) on dislocation and polyhedral substructure of crystals in the presence of surface-active impurities (KJ), A. A. Shatalov (Kiyev) on the development of lattice defects, R. Ya. Gindina (Tartu) on the marking of defects in NaCl and KCl by nonisomorphic impurities, A. Ya. Pae and A. A. Khaav (Tartu) on results of X-ray structural analyses, O. G. Mankin and N. Ye. Lushchik (Tartu) on absorption

investigations of the diffusion of Ga^+, In^+, Sn^{++}, Cu^+, and Ag^+ ions, L. M. Belyayev, G. F. Dobrzhanskiy, V. V. Chadayeva, V. P. Panova, Z. B. Perekalina, and V. N. Variolomeyeva (Moscow) on the activation of Lithium fluoride, A. A. Vorob'yev, P. A. Savintsev, V. Ye. Averichev, A. A. Botaki, V. Ya. Zelenko, and M. N. Ignat'yeva (Tomsk) on the relationship of electrical, optical, mechanical, and other properties with the composition of crystals, Ye. K. Zavadovskaya, M. S. Ivankina, I. Ya. Melik-Gaykazyan, and M. N. Treskina (Tomsk) on the influence of the decomposition of solid solutions upon their properties, and A. A. Vorob'yev, G. A. Vorob'yev, K. K. Sonchik, V. D. Kuchin, A. V. Astafurov, and M. A. Mel'nikov (Tomsk) held the final speech, which was followed by a discussion.

S/613/61/000/014/001/019
D207/D301

24.3500

AUTHOR: Lushchik, Ch. B.

TITLE: Principles of spectral transformation of light by ionic crystals

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy. No. 14, 1961. Issledovaniya po lyuminestsentsii 3 - 30

TEXT: The author discusses the mechanism of luminescence using the experimental data obtained in Tartu and Riga on alkali-halide phosphors activated with mercury-like ions: Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+}, Pb^{++}. Luminescence centers in these phosphors were assumed to be the activator ions at cation sites. The author considers the following cases of transformation of light by alkali-halide phosphors: (1) Participation of two electron states of a luminescence center; (2) participation of three or more electron states of the center; (3) sensitized migration of energy between centers; (4) participa-

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Principles of spectral ...

tion of elementary excitations of the crystal matrix; (5) optical stimulation of excited crystals. It is concluded that the quantum yield of luminescence for a single emission band depends step-wise on the frequency of exiting light ν_{exc}. In the absence of nonlinear effects within a single absorption band the quantum yield is independent of ν_{exc}. The yield is, in general, different for different absorption bands. The lack of dependence of the quantum yield on the excitation frequency within a single absorption band is a consequence of the quantum equivalence law of Einstein (1905) which says that each absorbed quantum produces one emission quantum. The principal reason for the constancy of the quantum yield within a single absorption band is the thermostat-like action of the lattice surrounding "absorption centers". Acknowledgments are made to the author's co-workers F.N. Zaitov, Kh. F. Kyaembre, G. G. Liyd'ya, N. Ye. Lushchik, E. S. Tiysler, K.K. Shvarts and particularly to I.V. Yaek, whose experimental work formed the basis of this article. There are 10 figures and 87 references: 65 Soviet-bloc and 22 non-Soviet bloc. The 4 most recent references to the English-language

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S/613/61/000/014/001/019
D207/D301

Principles of spectral ...

publications read as follows: M. Lax, J. Chem. Phys., 20, 1752 (1952); D. Dexter, C. Klickand, G. Russell, Phys. Rev., 100, 603 (1955); P. Johnson and F. Williams, Phys. Rev., 95, 69 (1954); Ch. B. Lushchik, "Color centers in alkali halides", International Symposium, Oregon, U.S.A., 1959, p. 29.

SUBMITTED: August 11, 1960

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S/613/61/000/014/009/019
D207/D303

AUTHORS: Lushchik, Ch. B., and Uybo, L. Ya.

TITLE: Physical processes in ammonium-halide crystals

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy. No. 14, 1961. Issledivaniya po lyuminestsentsii, 190-211

TEXT: The authors review published work on various physical (mainly optical) properties of ammonium-halide crystals (AM) and compare them with the known properties of alkali-halide crystals (AL) noting similarities and differences. The interest in AM crystals is the next logical step after exhaustive studies of the simplest crystals which are alkali halides. NH_4F, NH_4Cl, NH_4Br and NH_4I are mentioned by the authors, but only the last three are discussed in detail. NH_4^+ ions, like alkali ions, are bound to halogens by ionic bonds. AM crystals, like AL compounds, are cubic in struc-

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ture: NH_4Cl and NH_4Br are b.c.c. (CsCl type), but NH_4I is f.c.c. (NaCl type). Cooling AM crystals produces transformations from NaCl to CsCl type and to less symmetric structures. AM crystals sublime easily and in this respect they differ from AL compounds. V-centers (v^+p, where v^+ is a cation vacancy and p is a hole) and Tl^+ centers are similar in AM and AL crystals, but F-centers (v^-e, where v^- is an anion vacancy and e is an electron) differ in AM and AL crystals. This difference is due to F-centers interacting with NH_4^+ ions in AM crystals and with alkali ions in AL crystals; V-centers and Tl^+ centers interact with the same halogen ions both in AM and AL compounds. Optical characteristics (absorption) of excitons of AM and AL crystals are similar and exciton processes are analogous. Hole color centers responsible for low-temperature thermoluminescence and hole processes are similar in AM and AL crystals. All these observations show that processes or properties involving the anion sublattice are very similar in AM and AL cry-

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stals because that sublattice consists of halogens and is, therefore, nearly the same in both types of crystals. Processes and properties which involve the cation sublattice are different in AM and AL crystals because NH_4^+ and alkali ions differ considerably in properties. The complex luminescence mechanism of ammonium-halide phosphors is considered in some detail. Acknowledgments are made to G. G. Liyd'ya, N. Ye. Lushchik and I. V. Yaek for their help in preparing this paper. There are 9 figures and 59 references: 35 Soviet-bloc and 24 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: M. Veta, M. Hirai and H. Watanabe, J. Phys. Soc. Japan, 14, 253 (1959); D. Dexter, Phys. Rev., 108, 707 (1957); R. Knox and N. Inchauspe, Phys. Rev., 116, 1093 (1959); J. Eby, K. Teegarden and D. Dutton, Phys. Rev., 116, 1099 (1959).

SUBMITTED: July 25, 1960

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S/613/61/000/014/019/019
D207/D303

AUTHORS: Zazubovich, S. G., Lushchik, N. Ye., and Lushchik, Ch. B.

TITLE: Polarized luminescence of the KCl:Bi phosphor

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy. No. 14, 1961. Issledovaniya po lyuminestsentsii, 292-293

TEXT: The authors investigated the luminescence of the KCl:Bi phosphor and found that Bi^{3+} emission was polarized. The degree of polarization, $P = (I_{\parallel} - I_{\perp})/(I_{\parallel} + I_{\perp})$, for the 3.5 - 3.9 eV excitation band was not greatly affected by the exciting frequency and reached 0.8. Comparison of the angular dependence of polarization with P. P. Feofilov's theory (Ref. 3: Polyarizovannaya lyuminestsentsiya atomov, molekul i kristallov (Polarized Luminescence of Atoms, Molecules and Crystals), GIFML, Moscow, 1959) showed that fundamental oscillators where linear electric dipoles aligned along C_4 axes, i.e. along the cation-anion direction. The absorp-

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