"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

tion is due to $^1S_0 \rightarrow {}^3P_1$ transitions. The high degree of polarization of KCl:Bi luminescence was due to point defects next to Bi^{3+} ions which impede reorientation of P electron-density "dumb-bells" along C_4 axes. After X-ray radiation of KCl:Bi, the number of Bi^{3+} centers was found to be strongly reduced. Simultaneously new activator centers, Bi^{2+}, appeared in the phosphor. The excitation spectrum of the new centers was peaked in the region of 4.25 eV and the emission band had a maximum at 2.9 eV. Luminescence of Bi^{2+} centers was practically unpolarized; this is in agreement with the absence of polarization of luminescence due to $^2S_{1/2}$ $^2P_{1/2}$ transitions in free Bi^{2+} ions. Detailed results will be published later. There are 4 Soviet-bloc references.

SUBMITTED: April 29, 1961

Card 2/2

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24.7500,

S/058/62/000/008/046/134
A061/A101

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

TITLE: Electron-vibrating processes in the luminescence centers of ionic crystals with the participation of some excited states

PERIODICAL: Referativnyy zhurnal, Fizika, no. 8, 1962, 43, abstract 8V299 ("Tr. In-ta fiz. i astron. AN EstSSR", 1961, no. 15, 30 - 55; summary in English)

TEXT: The dependence of spectra and quantum yield of luminescence in KCl-In, KBr-In, KBr-Ga, KBr-Sn, KBr-Tl, KBr-Pb, and KI-Tl phosphors on the frequency of exciting light has been investigated at 100 and 295°K. Emission spectra of impurity centers in crystals and of free mercury-like ions are compared in detail. The mechanism of nonradiative $^1P_1 \rightarrow {}^3P$ transitions and the effect of "agitation" of electronic states in luminescence centers are discussed. There are 28 references.

[Abstracter's note: Complete translation]

Card 1/1

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

24.7100

S/058/62/000/008/043/134
A061/A101

AUTHORS: Lushchik, Ch. B., Liyd'ya, G. G., Soovik, T. A., Yaek, I. V.

TITLE: The mechanism of the luminescence of alkali halide crystals under excitation by ultraviolet and hard radiations

PERIODICAL: Referativnyy zhurnal, Fizika, no. 8, 1962, 42, abstract 8V294 ("Tr. In-ta fiz. i astron. AN EstSSR", 1961, no. 15, 103 - 126; summary in English)

/B

TEXT: The physical processes taking place in ionic crystals under the action of UV and hard radiations are examined. Attention is chiefly devoted to the interaction of different elementary excitations of the basic substance with luminescence centers. An attempt is made to appraise the relative role of exciton and electron-hole processes in gamma and R luminescence. There are 76 references.

[Abstracter's note: Complete translation]

Card 1/1

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

S/613/61/000/017/003/011
D051/D113

24,3500 (1137,1138,1163)

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

TITLE: Polarization characteristics of some alkali halide crystal phosphors

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy, no. 17, 1961. Issledovaniya po lyuminestsentsii, 38-49

TEXT: The polarization characteristics of the luminescence of alkali halide crystals activated by mercury-like (Ga^+, In^+, Tl^+, Pb^{++}, Bi^{+++}) and noble (Cu^+, Ag^+, Au^+) ions were investigated. The study was conducted so as to explain how far activator ions interact with different types of crystal defects and whether these defects spread to luminescence centers whose "core" is composed of mercury-like and noble ions. The polarization method employed was developed by P.P.Feofilov who used it to reveal the anisotropy of colored centers and luminescence centers established by rare earth ions

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Polarization characteristics ...

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in certain metal fluorides. It was shown that the emission of the main luminescence centers at 293° K is not polarized in most phosphors. The luminescence centers in KCl-Bi and NaCl-Ag phosphors reveal a strong polarization of luminescence. Azimuthal dependences of the degree of polarization show that the oscillators are oriented along the C_4 axes. It is doubtful whether such an orientation testifies to an anion defect near the activator. The polarization diagram of KCl-Bi corresponds to that of absorption and emission by electric linear oscillators. The polarization spectra of KCl-Bi, NaCl-Ag, KCl-Tl, and NaCl-Tl were investigated and discussed. There are 6 figures. The most important English-language reference is: C.Click, W.Compton, Phys.Chem. Solids, 7, 170, 1958;

SUBMITTED: April 21, 1961

Card 2/2

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, Ch.B.; LIYD'YA, G.G.; LUSHCHIK, N.Ye.; SHVARTS, K.K.; YAEK, I.V.

Physical processes in alkali halide crystal phosphors activated by mercury-like ions. Fiz.tver.tela 3 no.4:1176-1184 Ap '61. (MIRA 14:4)

1. Institut fiziki i astronomii AN Estonskoy SSR, Tartu.
(Phosphors)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, Ch.B.; SHVARTS, K.K.

Second conference on the physics of alkali halide crystals. Opt.i spektr. 11 no.4:560-562 O '61. (MIRA 14:10)
(Alkali metal halide crystals--Congresses)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, Ch. B.

89237

S/048/61/025/001/003/031
B029/B067

9.6150 (also 1137, 1395)

AUTHORS: Luchik, Ch. B., Liyd'ya, and Yaek, I. B.

TITLE: Mechanism of the processes of energy accumulation by crystal phosphors

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, v. 25, no. 1, 1961, 23-27

TEXT: The present paper deals with the following mechanisms of energy accumulation by crystal phosphors: production mechanism of F-centers in crystals, and mechanisms of thermal and optical "de-excitation" of ion crystals. Three stages are distinguished in energy accumulation by crystals: 1) production of a long-lived excited state; 2) long-lasting conservation of the excited state; 3) processes of "de-excitation" of the crystal. D. I. Blokhintsev (Ref. 1) showed that the electrons and holes occurring after excitation are localized at lattice defects which are far from one another. For this reason, their direct recombination is impossible, and the electrons or holes must be set free from the trapping centers for "de-excitation" of the crystal. Intense ion diffusion prevents

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the crystal from remaining in the excited state for a long time. Even in the production of the simplest F-centers it is necessary to take account of both the active role of electron - hole processes and exciton, sensitizing, ion processes, etc. The number, n_F, of F-centers can be concluded either from the absorption $\chi_F \sim n_F$, from the intensity of luminescence photo-stimulated in the F-region, or from the electron emission photo-stimulated from the F-centers. The accuracy of the two last-mentioned methods exceeds the first by several orders of magnitude. Fig. 1 shows the absorption spectra (1) and the spectra of the production of F-centers (2) for the phosphors KCl - Ca, Tl; KBr - Ga; KBr - In; and KBr - Tl. According to the data obtained, the $^1P_1$ states of monovalent impurity ions can be "de-localized" with a certain probability, which results in the formation of F- and V-centers in the basic material of the crystal. Fig. 2 shows the spectrum of the production of F-centers in KI - Tl as measured by the luminescence method. F-centers are formed not only in the ac region but also in the ex ($\sim$220 mμ) and ep regions ($\sim$190 mμ) with even stronger efficiency. The production mechanisms of F-centers in the ex- and

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ep-regions differ from each other. The dislocation mechanism of the production of F-centers needs additional investigations. The authors then discuss the mechanisms of thermal and optical de-excitation of ion crystals. The third stage of the phenomenon studied here has been investigated in previous papers. The thermal destruction of F-centers in alkali-halide crystals does not lead to their direct thermal ionization. For the NaCl, KCl, and KBr crystals, the thermal destruction of F-centers in the range 100-300°K is connected with hole processes; in the range 400-500°K, however, it is related to electron processes. The ultraviolet radiation at the same frequencies (in the ex and ep regions) is capable of producing and destroying F-centers. Finally, the authors demonstrate that alkali-halide salts are typical crystal phosphors. During an investigation of the luminescence of alkali-halide salts with excitation in the region of self-absorption of the crystal it has been found that many phenomena observed in these crystals are the same as in ZnS phosphors. This investigation was carried out at Tartu. Further details on this subject will be published later. This is the reproduction of a lecture read at the Ninth Conference on Luminescence (Crystal Phosphors), Kiyev, June 20-25, 1960. There are 2 figures and 38 references: 32 Soviet-bloc and 5

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Mechanism of the processes of energy S/048/61/025/001/003/031
B029/B067

non-Soviet-bloc.

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

Legend to Fig. 1: spectra of absorption (1), of F-center production (2), of negative, excited absorption (3), and of the production of activator centers (4).
Legend to Fig. 2: 1) absorption spectrum, 2) spectrum of the excitation of steady luminescence, 3) of recombination phosphorescence, 4) of optical flash-up, 5) and 6) emission spectra in the case of steady luminescence and optical flash-up, 7) spectra of the stimulation of optical flash-up

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ACCESSION NR: AR3006305 S/0058/63/000/007/D080/D080

SOURCE: RZh. Fizika, Abs. 7D580

53

AUTHOR: Lushchik, Ch. B.

TITLE: Photophysical processes and migration of energy in alkali-halide crystal phosphors

CITED SOURCE: Sb. Fiz. shchelochno-galoidn. kristallov. Riga, 1962, 245-261. Diskus., 261-262

TOPIC TAGS: phosphor, alkali-halide crystal, energy migration, photophysical process

TRANSLATION: A comparative investigation was made of different mechanisms of energy migration (EM) in alkali-halide crystals activated by mercury-like ions. The following are considered and discussed: 1) EM between impurity centers; 2) exciton processes and EM;

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3) EM from the main substance to the impurity centers, due to displacements of electrons and holes; 4) EM from impurity centers to the main substance of ionic crystals ("delocalization of the excitations"); 5) EM from the main substance to the color centers in previously excited ionic crystals. Bibliography, 100 titles. T. Eksina.

DATE ACQ: 15Aug63 SUB CODE: PH ENCL: 00

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

S/613/62/000/018/001/013
E039/E120

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

TITLE: Polarised luminescence of the mercury-like centres of cubic crystals. I.

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy. no.18, 1962. Issledovaniya po lyuminestsentsii. 3-22

TEXT: The polarisation characteristics of the Sn^{++} and Pb^{++} centres in alkali halide phosphors are investigated in detail and the relative literature is reviewed. Single crystals are grown from solutions using "spectroscopically pure" NaCl and "specially pure" KCl, KBr and KI. The concentrations of impurity centres, estimated from the absolute value of the absorption coefficients, are in the range 0.001 to 0.01 mole%. Phosphors activated by Sn and Pb form unstable solid solutions, hence before measuring they are quenched by rapidly cooling from a temperature of 650-700 °C to 20 °C. Polarisation spectra of the crystals are measured at 293 and 100 °K. The exciting light is incident, normal to the (100) plane along the x axis, the electric vector being orientated

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along the C_4 axis (z axis) of the crystal. Polarised luminescence is observed along the y axis perpendicular to the exciting light. Measurements are made on these phosphors using different filters and the absorption and emission spectra are also obtained. The azimuthal dependence of the degree of polarisation shows that the oscillations of the Sn^{++} and Pb^{++} centres are orientated along the C_4 axis. The polarisation spectra have complex structures and are shown to be correlated with the activator absorption spectra. The polarisation diagram of KBr-Sn, measured for the long-wavelength absorption band corresponds to that of absorption and emission by electric linear oscillators ($\pi_e - \pi_e$). An analysis of the polarisation characteristics permits of a more accurate interpretation of the electronic structure of the spectra of mercury-like centres.
There are 8 figures and 1 table.
SUBMITTED: December 29, 1961

Card 2/2

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ACCESSION NR: AT4016307 S/0000/62/000/000/0245/0262

AUTHOR: Lushchik, Ch. B.

TITLE: Photophysical processes and energy migration in alkali halide crystallophosophors

SOURCE: Vses. soveshch. po fiz. shchelochnogaloidn. kristallov. 2d, Riga, 1961, Trudy*. Fiz. shchelochnogaloidn. kristallov (Physics of alkali halide crystals). Riga, 1962, 245-262

TOPIC TAGS: alkali halide crystal, photophysical process, impurity center, energy migration, crystallography, phosphor, crystal physical property, exciton

ABSTRACT: The article reviews the results of studies of energy migration in alkali halide crystallophors which have been conducted in recent years in Tartu and Riga. Impurity centers were used as sensitive probes to obtain deeper insight into the different types of migration. Minute analysis of peculiar spectral characteristics, rather than the geometrical method, was chosen as the method of investigation because of small energy migration distances. The author differentiates the following types of migration: 1) direct migration between impurity centers, 2) migration from the base to impurity

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centers in which exciton rearrangement is involved, 3) migration from the base to impurity centers caused by electron and hole motions, 4) migration from impurity centers to the base, and 5) migration from the base to color centers in pre-excited crystals. Since the studies of this subject are still in the initial stage, most data thus far obtained are tentative and allow only few conclusions, which may be summarized as follows: 1) energy resonance migration between impurity centers in ionic crystals is a rather common occurrence; 2) the Frenkel exciton concept, widely employed in spectral studies, is a productive and substantiated hypothesis; 3) ionic crystals optically resemble semiconductors with respect to zone-zone transitions; and 4) further studies are handicapped by the lack of theory for mutual transformation of various electron elementary excitations in ionic crystals. The literature on the subject is extensively discussed. Orig. art. has: 6 figures.

ASSOCIATION: Institut fiziki i astronomii AN Estonskoy SSR (Institute of Physics and Astronomy, Academy of Sciences of the Estonian SSR)

SUBMITTED: 00 DATE ACQ: 06Mar64 ENCL: 00

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

S/048/62/026/004/008/014
B104/B102

AUTHORS: Lushchik, Ch. B., Lushchik, N. Ye., and Yaek, I. V.

TITLE: Electron oscillation processes in luminescent centers of ionic crystals

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 4, 1962, 488-496

TEXT: On the basis of papers published from 1913 up to the present time, a review has been compiled on the rules governing the electron oscillation processes in ionic crystals. Special attention is devoted to effects involving excited states of impurity centers. Results obtained for alkali-halide crystals activated with Ga^{+}, Ge^{2+}, In^{+}, Sn^{2+}, Sb^{3+}, Tl^{+}, Pb^{2+}, and Bi^{3+}, and also for NaCl, KCl, KBr, and KI crystals activated with indium, gallium, antimony, germanium, and bismuth are discussed. This review article further deals with the steplike dependence of the quantum yield of photo-effects in ionic crystals on the frequency of the

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exciting light. There are 5 figures and 1 table.

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

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ACCESSION NR: AR4043997 S/0058/64/000/006/D074/D074

SOURCE: Ref. zh. Fizika, Abs. 6D557

AUTHOR: Lushchik, Ch. B.; Liyd'ya, G. G.; Soovik, T. A.

TITLE: The mechanism of luminescence of alkali-halide drystals on excitation by UV and hard radiation

CITED SOURCE: Sb. Stsintillyatory* i stsintillyats. materialy*. Khar'kov, Khar'kovsk. un-t, 1963, 110-113

TOPIC TAGS: luminescence, luminescence mechanism, alkali halide, alkali halide crystal, ultraviolet radiation, x ray radiation, gamma radiation, hard radiation

TRANSLATION: Using KI-Tl as an example, discusses the mechanism of luminescence of alkali-halide drystals during excitation by UV-, γ, and x-ray radiation. From a comparison of the kinetics of the build-up of luminescence, the effect on it of preliminary irradiation in the F-band, and thermal quenching of luminescence during various forms of excitation, the conclusion is drawn that in the luminescence of KI-Tl during excitation by hard radiation an essential role is played by the

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exciton mechanism of energy transfer from the lattice of the basic substance to the luminescence centers. Bibliography: 25 references.

SUB CODE: IC, OP ENCL: 00

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ZAZUBOVICH, S.G.; LUSHCHIK, N.Ye.; LUSHCHIK, Ch.B.

Optical structure of luminescence centers in ionic crystals activated by mercurylike ions. Opt. i spektr. 15 no.3:381-388 S '63. (MIRA 16:10)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ACCESSION NR: AT4020793 S/2613/63/000/023/0022/0037

AUTHOR: Lushchik, Ch. B.; Lushchik, N. Ye.; Muuga, I. A.

TITLE: Band spectra of crystals activated with mercury-like ions. Part I.

SOURCE: AN EstSSR. Institut fiziki i astronomii. Trudy*, no. 23, 1963, Issledovaniya po lyuminestsentsii (Research in luminescence), 22-37

TOPIC TAGS: luminescence, luminescence spectru, band spectrum, phosphor, phosphor luminescence, crystalline phosphor, mercury-like luminescence activator, crystal vibration

ABSTRACT: The method of luminescent probes may be successfully used for the study of physical phenomena in solid bodies. Rare-earth ions, which give off a linear emission of complex structure, are most frequently employed as the probes. The author also notes that the so-called mercury-like ions (Ga^{+}, Ge^{2+}, In^{+}, Sn^{2+}, Sb^{3+}, Tl^{+}, Pb^{2+}, Bi^{3+}) may be used in investigating the physical processes in alkali halide crystals. A detailed study of the spectral characteristics of alkali halide crystals, activated with mercury-like ions, has demonstrated that in these phosphors the absorption and emission spectra at 100K (for KCl–Tl even at 4.2K) are continuous bands without an oscillating structure. The sharp difference in spectra for mercury-like centers in crystals of the types AIIBVI and AIBVII,

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ACCESSION NR: AT4020793

which are structurely similar, deserves careful attention. The purpose of the present work was to determine the conditions necessary for the observation of a vibrational structure in the spectra of mercury-like centers. The authors have attempted to utilize luminescent ions for an experimental investigation of the vibrational processes in the crystals. The shapes of the emission and excitation spectra of KCl-Bi, $Ca_3(PO_4)2$-Bi, CaO-Bi and CaS-Bi phosphors were investigated at 295 and 100K. The phosphors with large Stokes losses (KCl-Bi) have continuous emission and excitation spectra. In the case of phosphors having relatively small Stokes losses (CaO-Bi), at 100K a series of clearly marked equidistant bands were observed against the background of the continuous emission and excitation spectra. The authors discuss the characteristic features of the continuous and band spectra, and their electronic ($^1S_0 \rightleftarrows {}^3P_1$ and ${}^3P_0 \rightarrow {}^1S_0$ transitions in Bi^{3+} centers) and vibrational structure. The hypothesis is advanced that the band spectra arise as the result of the interaction of the electrons with the localized modes of vibration which, in turn, interact with the crystal vibrations. The authors found, in conclusion, that mercury-like centers with small Stokes losses may serve as convenient luminescent probes for the investigation of vibrational processes in solid bodies. "We are grateful to N. Kristofel', V. Khizhnyakov and G. Zavt for their discussion on the theoretical work in electron-phonon interaction in crystals and to K. K. Rebane for critical remarks." Orig. art. has: 1 table and 3 figures.

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APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ACCESSION NR: AT4020793

ASSOCIATION: Institut fiziki i astronomii AN EstSSR (Institute of Physics and Astronomy, AN EstSSR)

SUBMITTED: 21Jan63 DATE ACQ: 07Apr64 ENCL: 00

SUB CODE: PH NO REF SOV: 023 OTHER: 013

Card 3/3

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ZAZUBOVICH, S.G.; LUSHCHIK, N.Ye.; LUSHCHIK, Ch.B.

Electronic vibrational processes and the polarized luminescence of mercurylike centers in cubic crystals. Izv. AN SSSR Ser. fiz. 27 no.5:656-660 My '63. (MIRA 16:6)

1. Institut fiziki i astronomii AN Estonskoy SSR.
(Phosphors—Spectra) (Quantum theory)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, Ch. B.; ANTONOV-ROMANOVSKIY, V. V.

"General Discussions of Phosphors"

Report presented at the International Conference on Luminescence, Torun, Poland, 25-29 Sept 63.

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ACCESSION NR: AP4043338 S/0181/64/006/008/2256/2262

AUTHORS: Lushchik, Ch. B.; Liyd'ya, G. G.; Elango, M. A.

TITLE: Electron-hole mechanism of production of color centers in ionic crystals

SOURCE: Fizika tverdogo tela, v. 6, no. 8, 1964, 2256-2262

TOPIC TAGS: color center, ionic crystal, electron bombardment, x ray irradiation, color center, ultraviolet irradiation, alkali halide, crystal lattice defect

ABSTRACT: The present communication is a direct continuation of a cycle of investigations carried out by their laboratory to clarify the mechanism whereby ionic crystals become colored by ultraviolet radiation, x-rays, and radiation from reactors. Natural crystals of NaCl and crystals of NaCl.Tl and KCl.Ag grown from melts of especially pure salts by the Kiropoulos method were irradiated in

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ACCESSION NR: AP4043338

the vertical channel of the IRT-2000 reactor, and also with x-rays (60keV), slow electrons (150 eV), and ultraviolet radiation (5--14 eV). The authors were especially interested in elementary processes which occur during a complicated phenomenon such as radiation coloring of ionic crystals, and paid consequently special attention to a parallel investigation of the production of F centers by these type of radiations. It is shown that irradiation of the crystals leads not only to a filling of the anion vacancies by electrons, but also to generation of a large number of new point defects and their clustering. Only the electron-hole mechanism of F-center production is considered in detail, the others having been treated by the authors in numerous other papers. It is pointed out, however, that this is not the only possible mechanism. "We are deeply grateful to K. K. Shvarts for collaboration and to G. Va[illegible]e, E. Il'mas, T. Eksina, and I. Yaek for participating in the experiments and a discussion of the results." Orig. art. has: 6 figures.

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APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ACCESSION NR: AP4043338

ASSOCIATION: Institut fiziki i astronomii AN ESSR, Tartu (Institute of Physics of Astronomy, AN ESSR)

SUBMITTED: 28Dec63

ENCL: 00

SUB CODE: OP, SS

NR REF SOV: 031

OTHER: 008

Card 3/3

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 20763-65 EEC(b)-2/EPF(c)/EPF(n)-2/EWT(1)/EWT(m)/T Pr-4/Pu-4 IJP(c)/
SSD(c)/AFWL/ASD(a)-5/ASD(m)-3/APETR/APTC(a)/ESD(gs) GG

ACCESSION NR: AT5000396 S/3119/64/000/001/0015/0025

AUTHOR: Lushchik, Ch.B., Liyd'ya, G.G., Elango, M.A.

B+1

TITLE: Study of the processes of generation of radiation-induced defects in ionic crystals

SOURCE: AN LatSSR. Institut fiziki. Radiatsionnaya fizika, no. 1, 1964. Ionny*ye kristally* (Ionic crystals), 15-25

TOPIC TAGS: alkali halide crystal, crystal lattice, lattice defect, radiation defect, color center, thallium activator, ultraviolet irradiation

ABSTRACT: The object of this work was to study the creation of color centers in NaCl single crystals by x-rays and by irradiation in the vertical channel of the IRT reactor of the Institut fiziki AN Lat.SSR (Physics Institute of the Academy of Sciences of the Latvian SSR). The study is a direct continuation of a series of investigations conducted at the Institut fiziki i Astronomii AN Est.SSR (Institute of Physics and Astronomy of the Academy of Sciences of the Estonian SSR) and aimed at elucidating the mechanisms governing the coloration of ionic crystals by ultraviolet light. Spectra of the creation of color centers in thin films of KI-Tl by monochromatic ultraviolet radiation were recorded. Electron, exciton, and ionization mechanisms of the creation of color centers and radiation-induced defects in

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L 20763-65
ACCESSION NR: AT5000306

6

ionic crystals are discussed on the basis of the data obtained and literature data. "In conclusion, the authors express their appreciation to K.K. Shvarts for his collaboration in the work and for reviewing the results, as well as to V.P.Denks, E.R. Il'mas, and R.A. Kink for their participation in the experiments." Orig. art. has: 6 figures.

ASSOCIATION: Institut fiziki i astronomii AN Est. SSR (Institute of Physics and Astronomy, AN Est.SSR); Institut fiziki AN Lat.SSR (Physics Institute, AN Lat.SSR)

SUBMITTED: 18Mar64 ENCL: 00 SUB CODE: OP, SS

NO REF SOV: 025 OTHER: 034

Card 2/2

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 60916-65 EWT(m)/EPF(c)/EPF(n)-2 GG
ACCESSION NR: AT5013535 UR/2613/64/000/026/0093/0111

16 21

AUTHORS: Lushchik, Ch. B.; Elango, M. A. 9 81

TITLE: On the mechanisms of radiation-induced coloration of ionic crystals

SOURCE: AN EstSSR. Institut fiziki i astronomii. Trudy, no. 26, 1964 Issledovaniya po lyuminestsentsii (Research on luminescence), 93-111

TOPIC TAGS: ionic crystal, color center, F center, radiation coloring, x irradiation, ultraviolet irradiation, Gamma irradiation, coloration mechanism

ABSTRACT: In view of the fact that no detailed studies were made of the coloring of ionic crystals by ionizing radiation or ionizing particles, in spite of many hypotheses advanced, the authors investigated the production of F centers in NaCl and NaCl-Tl single crystals with ultraviolet radiation (6 -- 12 eV) and with x-rays (60 kV). The single crystals investigated were natural NaCl having very few point

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defects but a high dislocation density, and artificial NaCl and NaCl-Tl containing relatively few dislocations but more point defects. The absorption spectra were measured with a vacuum monochromator. To determine the detailed micromechanism of color-center production, the authors analyze separately the effects of the electronic, exciton, electron-hole, and ionization mechanisms of radiation-induced coloration. It is suggested that at room temperature the greatest contribution to radiation coloring of ionic crystals is made by the interaction between elementary excitations and associates of point defects and dislocations. A scheme showing the sequence of the physical processes occurring in the production of F centers by x-rays and gamma rays during individual coloring stages is proposed. 'The authors thank G. Liyd'ya and I Yaek for participation in a discussion of the results, and to E. Il'mas and R. Kink for help with the work.' Orig. art. has: 5 figures and 1 table.

ASSOCIATION: Institut fiziki i astronomii AN EstSSR (Institute of Physics and Astronomy, AN EstSSR)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

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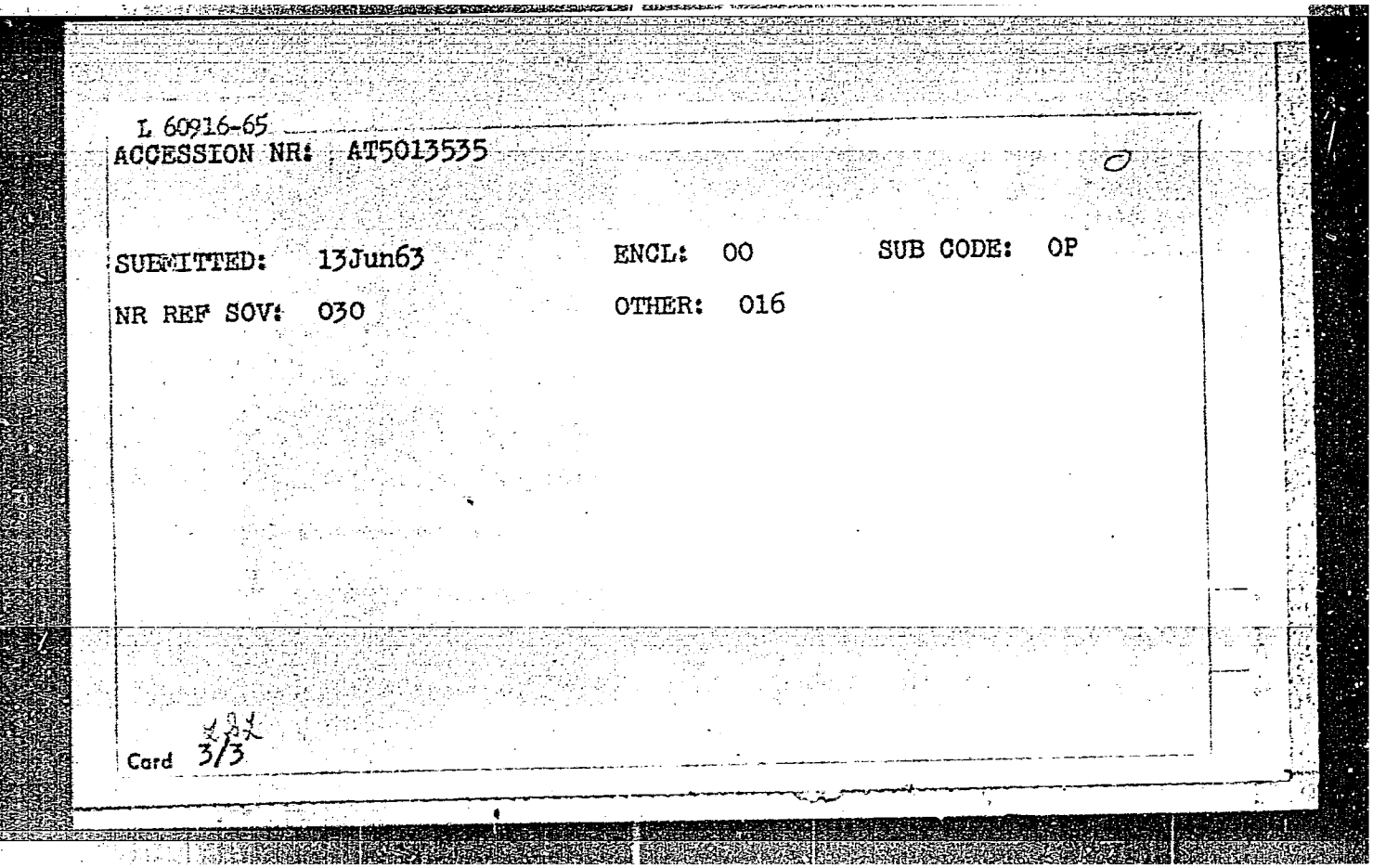

L 60916-65
ACCESSION NR: AT5013535

SUBMITTED: 13Jun63 ENCL: 00 SUB CODE: OP

NR REF SOV: 030 OTHER: 016

Card 3/3

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 60903-65 EWT(1) LJP(c)
ACCESSION NR: AT5013545 UR/2613/64/000/026/0213/0215

AUTHORS: Il'mas, E. R.; Liyd'ya, G. G.; Lushchik, Ch. B.

TITLE: Photon multiplication as an elementary act of the scintillation process

SOURCE: AN EstSSR. Institut fiziki i astronomii. Trudy, no. 26, 1964. Issledovaniya po lyuminestsentsii (Research on luminescence), 213-215

TOPIC TAGS: photon multiplication, scintillation counting, alkali halide crystal, photon yield, quantum yield

ABSTRACT: For the purpose of an experimental investigation of the elementary scintillation act, wherein one quantum of ultraviolet radiation is transformed into two quanta of visible light ($\eta = 2$), the authors succeeded to obtain photoluminescence with $\eta > 1$ and a series of single crystals of KCl, KBr, and KI activated with thallium and indium. The excitation source was a powerful discharge in hydro-

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ACCESSION NR: AT5013545

gen, neon, or helium in a flow-through quartz lamp, making it possible to experiment in the spectral range from 5 to 21 eV. The luminescence excitation spectra were measured at 293K at 90° to the direction of excitation by means of a sensitive photoelectric photometer, relative to sodium salycilate standard. The quantum yield began to increase with increasing frequency, starting with 11, 13.5, and 16.7 eV for KI-In, KBr-In, and KCl-Tl respectively, and exceeding unity for KI-In and KBr-In. The photon multiplication began at a photon energy approximately double the width of the forbidden band, apparently as a result of generation of two electron-hole pairs by a single quantum. A detailed report will be published in the journal 'Optika i spektroskopiya.' Orig. art. has: 1 figure

ASSOCIATION: Institut fiziki i astronomii AN EstSSR (Institute of Physics and Astronomy, AN EstSSR)

SUBMITTED: 22May64 ENCL: 00 SUB CODE: OP

NR REF SOV: 004 OTHER: 002

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APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 60918-65 EWT(1)/EEC(b)-2/T IJP(c) GG

ACCESSION NR: AT5013547 UR/2613/64/000/026/0219/0222

A18 B41

AUTHOR: Denks, V. P.; Lushchik, Ch. B.

TITLE: Experimental separation of neutral and charged elementary excitations in ionic crystals 21

SOURCE: AN EstSSR. Institut fiziki i astronomii. Trudy, no. 26, 1964. Issledovaniya po lyuminestsentsii (Research on luminescence), 219-222

TOPIC TAGS: elementary excitation, ionic crystal, exciton, electron hole excitation

ABSTRACT: The authors describe briefly the results of experiments in which neutral excitations were separated from charged ones by studying the effect of an electric field on the luminescence of ionic crystals. The experiments were carried out on single-crystal KI-Tl with a thallium concentration 0.03 mol.%. The average field in the crystal was 100 kV/cm. The crystal was irradiated with monochromatic ultraviolet radiation. Application of a negative potential to the illuminated surface of the crystal resulted in an instantaneous attenuation of the intensity of the thallium luminescence (emission band with maximum at 3.0 eV). The experiments have shown that both the decrease in intensity and its relative value are strongly dependent on the frequency of the exciting ultraviolet radiation, the quantum intensity of which was maintained constant. Application of the electric field is shown

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L 60918-65

ACCESSION NR: AT5013547

to influence only the time-delayed luminescence of the Tl^+ centers, connected with the electron-hole processes, so that this procedure makes it possible to separate the charged excitations from the neutral ones. It is planned to carry out such a separation for many alkali-halide crystals in a broad spectral region from 5 to 21 eV. Details of this field effect can be found in a companion paper by one of the authors (Denks, Trudy IFA AN ESSR, no. 26, 213 1964; Accession AT5013548). Orig. art. has: 1 figure.

ASSOCIATION: Institut fiziki i astronomii AN EstSSR (Institute of Physics and Astronomy, AN EstSSR)

SUBMITTED: 30Jun64 ENCL: 00 SUB CODE: OP, SS

NR REF SOV: 005 OTHER: 004

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 60351-65 EWT(l)/EWT(m)/T/EWP (t)/EEC(b)-2/EWP(b)/EWA(c) Pi-4 IJP(c)
ACCESSION NR: AT5013686 JD/GG UR/2613/64/000/030/0003/0015

43
AUTHOR: Vaia, G. K.; Gindina, R. I.; Lushchik, Ch. B.; Elango, A. A. 42
B+1

TITLE: Electronic processes in ionic-crystal whiskers 18 21

SOURCE: AN EstSSR. Institut fiziki i astronomii. Trudy, no. 30, 1964. Issledovaniya po lyuminestsentsii (Research on luminescence), 3-15

TOPIC TAGS: ionic crystal, filamentary crystal, electronic process, energy migration, color center, electron vibrational process, radiation coloration

ABSTRACT: The article reports the results of comparative investigations of the optical characteristics of ordinary and whisker-type alkali-halide crystals (NaCl, KCl, KCl-Tl, and KIn-Tl) and on determining the nature of the luminescence centers, energy migration from the main substance to the luminescence centers, the occurrence of scintillations induced by alpha particles, and the kinetics of production of color centers by means of x-rays. The tests were made on pure NaCl, KCl, KBr, and KI whiskers and on activated KCl-Ag, NaCl-Tl, NaCl-Ag, NaCl-Sn, and KI-Tl whiskers, which were found to have a minimum of imperfections or dislocations (with the exception of KCl-Ag). Measurement of the emission and excitation spectra have shown that the main luminescence centers in KI-Tl and KCl-Tl phosphors are not due to associations of the impurity atoms with dislocations. The highly perfect struc-

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L 60351-65
ACCESSION NR: AT5013686

ture of the whiskers results in a decrease in the energy loss when the energy migrates to the luminescence centers. The main luminescence centers as well as the F centers and the electro-vibrational processes in the centers are practically the same in crystals and in whiskers. Another similarity to ordinary imperfect crystals is that the x-ray coloration of the whiskers occurs in two stages. This means that the dislocation mechanism plays a smaller role in the coloration of ionic crystals than expected. Orig. art. has: 6 figures.

ASSOCIATION: Institut fiziki i astronomii AN EstSSR (Institute of Physics and Astronomy, AN EstSSR)

SUBMITTED: 07Oct64 ENCL: 00 SUB CODE: SS, OP

NR REF SOV: 014 OTHER: 010

Card 2/2

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 2836-66 EWT(l)/EWT(m)/T/EWP(t)/EWP(b) LJP(c) JD/JG/GG

ACCESSION NR: AT5021772 UR/2613/64/000/028/0003/0019

44,55 44,55 44,55

AUTHORS: Lushchik, N. Ye.; Lushchik Ch. B.; Liyd'ya, G. G.; Meriloo, I. A.

44,55 68 56 B+1

TITLE: Localized electronic excitations of ionic crystals, activated by mercury-like ions

21,44,55

SOURCE: AN EstSSR. Institut fiziki i astronomii. Trudy, no. 28, 1964. Issledovaniya po lyuminestsentsii (Research on luminescence), 3-19

TOPIC TAGS: luminescence property, luminescence research, luminescence, luminescence spectrum, luminescence yield, luminescent crystal, phosphor, gallium, indium, tin, tellurium, lead

ABSTRACT: In order to determine the nature of the excitation and energy migration in activated alkali halide crystals, the excitation spectra of 13 alkali halide crystals activated by Ga, In, Sn, Tl, and Pb in the spectral region 3-10 ev were investigated. The study is an extension of the previously reported work in the spectral region 2-6 ev by N. Ye. Lushchik, (Materialy VII Soveshchaniya po lyuminestsentsii (Kristallofosfory), Tartu, 1959, str. 27). Four series of experiments were performed

I	KF-In,	KCl-In,	KBr-In,	KJ-In,
II	KF-Tl,	KCl-Tl,	KBr-Tl,	KJ-Tl,

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L 2836-66

ACCESSION NR: AT5021772

III KCl-Ga, KCl-In, KCl-Sn, KCl-Tl, KCl-Pb,
IV KBr-Ga, KBr-In, KBr-Sn, KBr-Tl.

12

In series I and II, the activator was fixed (In or Tl), and the anion was varied. In series III and IV, the activator was varied, but the anion remained fixed (KCl or KBr). The experimental procedure followed was that of E. R. Il'mas, G. G. Liyd'ya, and Ch. B. Lushchik, (Opt. i spektr., 1964). Excitation spectra for the systems investigated are presented graphically, and the position of D absorption bands are tabulated. It was found that the excitation bands at the long wavelength tails of exciton absorption bands were almost independent of the activator, but depended substantially on the nature of the host anion. A model for near activator centers is proposed. It is concluded that the phosphors investigated exhibit activator as well as near activator electronic excitations. The authors thank E. R. Il'mas for the development of the ultraviolet vacuum experimental apparatus and R. A. Kink for his help, as well as A. A. Maaroos for the Tl determination in the phosphors. Orig. art. has: 2 tables and 6 graphs.

ASSOCIATION: Institut fiziki i astronomii, AN EstSSR (Institute for Physics and Astronomy, AN EstSSR)

SUBMITTED: 14Feb64 ENCL: 00 SUB CODE: SS, OP

NO REF SOV: 038 OTHER: 011

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 23096-65 EEC(b)-2/EWT(1) IJP(c)
ACCESSION NR: AP5001294 P/0045/64/026/03-/0703/0709

(5)

AUTHOR: Lushchik, Ch.; Jaek, I.

TITLE: Recombination luminescence of activated ionic crystals

SOURCE: Acta physica polonica, v. 26, no. 3-4, 1964, 703-709

TOPIC TAGS: recombination emission, recombination luminescence, luminescence, halide crystal, activated halide crystal, ionic crystal, impurity center, impurity conductivity, free electron, hole migration

ABSTRACT: Experimental results of delayed emission of alkali halide crystals activated by Ga, In, Tl, Sn, and Ag are discussed. It is shown that the delayed emission has the nature of recombination, a fact that is confirmed by the emergence of photoconductivity, thermostimulated current, and thermostimulated electron emission. An examination of the electrothermostimulated luminescence of surface-activated crystals shows that luminescence emerges, in the main, due to the recombination of free electrons with trapped holes. If exciting radiation is absorbed by impurities, the holes are localized immediately at the impurity centers. In optical excitation of "zone-zone" transition only some of the holes are

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L 23096-65
ACCESSION NR: AP5001294

confined to the impurity centers. At low temperatures, hole migration is frozen. Recombination luminescence of ionic crystals can result in some cases from the recombination of free electrons with trapped electrons at impurity centers. Recombination emission of impurity ions is generally observed in crystals in which the recombination centers of electrons and holes coincide with the luminescence centers. If the centers (as in the case of NaCl-Ti and Mn) are spatially separated, sensitized recombination luminescence occurs. "The authors thank G. Liidja, H. Kaambre, V. Denks, G. Zolotaryov, E. Tiisler, and M. Okk for their help in the investigation of KBr-In, KBr-Tl, and KCl-Ag phosphors." Orig. art. has: 3 figures.

ASSOCIATION: Institute of Physics and Astronomy, Academy of Sciences of the Estonian SSR, Tartu, USSR

SUBMITTED: 00 ENCL: 00 SUB CODE: OP, SS

NO REF SOV: 033 OTHER: 005

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APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 41323-65 EWT(1) Pi-4 IJP(c)

ACCESSION NR: AP5001295 P/0045/64/026/03-/0711/0717

AUTHOR: Lushchik, Ch.; Lushchik, N.

TITLE: Regularities of fluorescence in activated ionic crystals

SOURCE: Acta physica polonica, v.26, no. 3-4, 1964, 711-717

TOPIC TAGS: fluorescence, luminescence, ionic crystal, emission spectrum, excitation frequency, quantum efficiency, excited state, polarization, thermostatic action, impurity center, luminescence center

ABSTRACT: Basic regularities in the luminescence of impurity centers of KCl crystals activated by Ga, Ge, In, Sn, Tl, Pb, and Bi cations have been investigated at 100 and 295K. The experimental results for conjugated electronic-vibrational transitions (absorption and emission) show that: 1) the emission spectra do not depend on excitation frequency ν_e; 2) the quantum efficiency of luminescence does not depend on ν_e nor on light emission frequency ν_I; 3) the lifetime of excited states does not depend on ν_e or ν_I; and 4) the degree of polarization does not depend on either ν_e or ν_I. These regularities in luminescence result from the strong thermostatic action of the host lattice on luminescence centers. However, the reg-

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ACCESSION NR: AP5001295

ularities are generally not observed in processes involving more than the lowest and upper electronic states of the impurity centers, particularly at low temperatures. In this case the emission spectra and the quantum efficiency of luminescence depend on ν_e, the lifetime of excited states and degree of polarization depend on ν_e and ν_I, and the dependence is of a complex "step-like" nature. These peculiarities in the emission of ionic crystals are due to the absence of the equilibrium distribution of centers in the different electronic states resulting from the insufficient radiationless transition probabilities between the different excited states. "The authors thank S. Zazubovich, T. Soovik, and E. Realo for helping in the investigation of polarization characteristics and photoscintillation of KCl-Sn crystals." Orig. art. has: 3 figures.

ASSOCIATION: Institute of Physics and Astronomy, Academy of Sciences, Estonian SSR, Tartu

SUBMITTED: 00 ENCL: 00 SUB CODE: OP

NO REF SOV: 020 OTHER: 004

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 43879-65 EEC(b)-2/EWT(1)/T Pi-4 IJP(c) GG

ACCESSION NR: AP5006433 S/0051/65/018/003/0453/0460

22
B

AUTHOR: Il'mas, E. R.; Liyd'ya, G. G.; Lushchik, Ch. B.

TITLE: Photon multiplication in crystals. I. Luminescence excitation spectra of ionic crystals in the range from 4 to 21 eV

SOURCE: Optika i spektroskopiya, v. 18, no. 3, 1965, 453-460

TOPIC TAGS: ionic crystal, photon multiplication, excitation spectrum, luminescence excitation, luminescence yield, quantum yield

ABSTRACT: This is the first of a series of papers and is devoted to a convincing experimental proof of the existence of photon multiplication in crystals in the optical band. To this end, the authors measured the luminescence excitation spectra of 11 single-crystal phosphors KI-Tl, KI-In, RbI-Tl, RbI-In, CsI-Tl, CsI-In, KBr-Tl, KBr-In, KCl-Tl, KCl-In, and NaCl-Tl in the range from 4 to 21 eV. A vacuum SP-68 monochromator modified for luminescence measurement was used. The ultraviolet source was a quartz-capillary high-power lamp of construction described by F. I. Vilesov (PTE, no. 4, 89, 1958). The luminescence of the phosphors was registered with a photomultiplier through filters that separated the individual

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L 43879-65

ACCESSION NR: AP5006433 O

bands. The details of the test procedure are described. The results show that at energies above 12 eV the quantum yield of the activator luminescence increases, exceeding in many cases the near-unity quantum yield of luminescence produced by direct excitation of the luminescence centers. This demonstrates beyond any doubt that one exciting quantum can produce in ionic crystals two luminescence quanta, proving the existence of photon multiplication in the optical spectrum. The results show also that the stepwise character of variation of the quantum yield from activated ionic crystals as a function of the frequency of the applied light, indicated in earlier papers by one of the authors (Ch. B. Lushchik, Tr. IFA AN ESSR, no 14, 3, 1961 and others), is observed not only in the region of activator but also in the region of the fundamental absorption, at least up to 21 eV energy. Orig. art. has: 5 figures and 1 table.

ASSOCIATION: None

SUBMITTED: 08Apr64 ENCL: 00 SUB CODE: OP, SS

NR REF SOV: 014 OTHER: 019

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APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 45756-65 EWT(1)/T/EEC(b)-2 Pi-4 IJP(c) GG
ACCESSION NR: AP5011116 UR/0051/65/018/004/0631/0636

AUTHOR: Il'mas, E. R.; Liyd'ya, G. G.; Lushchik, Ch. B.

TITLE: Photon multiplication in crystals. II. Photon multiplication mechanisms

SOURCE: Optika i spektroskopiya, v. 18, no. 4, 1965, 631-636

TOPIC TAGS: alkali halide phosphor, quantum yield, optical activation, luminescence, photon multiplication, impurity center, photostimulated luminescence, exciton, electron hole multiplication

ABSTRACT: Part I of the article, published earlier (Opt. i spektr. v. 18, 453, 1965) demonstrated that the activator-glow quantum yield exceeds unity in some crystals excited in the region of the vacuum ultraviolet. The purpose of Part II was to ascertain the mechanism whereby the energy of one exciting quantum is transformed in the crystal into the energy of two or more luminescence quanta of equal frequency. To this end, the excitation spectra of the instantaneous stationary glow component and of the photostimulated luminescence were investigated in KI-Tl, KI-In, RbI-Tl, and RbI-In in the region from 4 to 21 ev. The experimental procedure was the same as described in Part I. The dependence of the

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ACCESSION NR: AP5011116

instantaneous and inertial stationary glow components on the frequency of the exciting light was studied. An analysis of the experimental data shows that there exist at least two mechanisms of photon multiplication: exciton and electron-hole. It is observed that in the region of photon multiplication the dependence of the yield on the intensity of excitation has singularities connected with the jump-like increase in the volume density of excitation. No mechanism connected with direct excitation of impurity centers by fast electrons could be detected in the experiment. Orig. art. has: 3 figures and 2 formulas. [02]

ASSOCIATION: None

SUBMITTED: 08Apr64 ENCL: 00 SUB CODE: OP, SS

NO REF SOV: 012 OTHER: 006 ATD PRESS: 4001

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 32824-65 EEC(b)-2/EWT(1)/EWT(m)/EWP(b)/T/EWP(t) IJP(c) JD
ACCESSION NR: AP5004513 S/0048/65/029/001/0010/0018

AUTHOR: Lushchik, Ch.B.

TITLE: Physical processes in luminescing ionic crystals /Report, 12th Conference on Luminescence held in L'vov 30 Jan-5 Feb 1964/

SOURCE: AN SSSR. Izvesity. Seriya fizicheskaya, v.29, no.1, 1965, 10-18

TOPIC TAGS: luminescence, ionic crystal, kinetics, exciton, excitation, impurity center

ABSTRACT: This is a review article discussing the work during the last decade of the Estonian group at Tartu concerning the physical processes in luminescent storage. This group has set itself the task of conducting detailed investigations of the physical processes involved in the direct excitation of luminescence centers, the migration of these excitations and the role of the simplest electron excitations of the host material; they have recently extended their investigations to higher energy electron excitations and have done considerable work in the vacuum ultraviolet out to 21 eV and with electrons of energies up to 5 keV. They have developed a "spectral-kinetic" method of investigating the kinetics of luminescence

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ACCESSION NR: AP5004513

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phenomena in time intervals from 10^{6} to 10^{-6} sec and hope to extend these investigations to intervals of 10^{-9} sec. Many of the findings of the Tartu group are mentioned with reference to the original publication and some are discussed briefly and illustrated with absorption spectra of indium or silver activated alkali halide crystals. The sequence of events involved in radioluminescence is conceived as follows: the initial x ray or γ ray produces a photoelectron or a Compton electron which in turn gives rise to a cascade of secondary electrons. The secondary electrons give rise, by obscure processes, to short-lived electron excitations, which are transformed into stable electron excitations. These excitations are trapped by impurity centers which, after intermediate internal processes, give rise to luminescence. Further experiments, particularly in the relatively unexplored energy region from 20 to 1000 eV, are required to determine how well the concepts developed by the Tartu group reflect the complex physical phenomena in ionic crystals. Orig. art.has: 5 figures.

ASSOCIATION: none

SUBMITTED: 00/--Jan65 ENCL: 00 SUB CODE:SS,OP

NR REF SOV: 046 OTHER: 007

Card 2/2

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 32825-65 EEC(b)-2/EWT(1)/T IJP(c)

ACCESSION NR: AP5004515 S/0048/65/029/001/0027/0035

AUTHOR: Il'mas,E.R.; Kink,R.A.; Li/d'ya,G.G.; Lushchik,Ch.B.

TITLE: Transformations of electron excitations in ionic crystals /Report, 12th Conference on Luminescence held in L'vov 30 Jan-5 Feb 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v.29, no.1, 1965, 27-35

TOPIC TAGS: luminescence, ionic crystal, exciton, quantum yield, alkali halide

ABSTRACT: The reflection spectra from the (100) surfaces of eight alkali halides were measured to a quantum energy of 14 eV with a vacuum monochromator and the results are presented graphically. These spectra show numerous peaks above a relatively smooth background; the peaks in the long wavelength portion of the spectra are characteristic primarily of the anion, and those in the short wavelength region, of the cation. The energies of the short wavelength peaks are close to the minimum excitation energies of the free cations. The excitation spectra of the stationary activator luminescence for a number of ionic crystals activated with In or Tl were measured by methods described elsewhere by three of the present authors (Optika i spektroskopiya 17, No.6,1964). The quantum efficiencies were obtained by correcting

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ACCESSION NR: AP5004515

for incomplete absorption and selective reflection, and the results for several alkali halides are presented graphically. Three regions can be distinguished in the KCl and KBr spectra, in each of which the quantum yield is approximately constant: the region of activator absorption, the longest wavelength exciton absorption band, and a broad region extending to about 14 eV in the chlorides. In several iodides an increase in quantum yield was observed at excitation energies above 10 or 12 eV. This is ascribed to a photon multiplication process discussed in the reference cited above. These experimental data are discussed in some detail in connection with other material in the literature. The striking fact that emerges is that the final results are the same whether the ionic crystal is excited by high energy photons or by low energy ones. It is concluded that the high energy excitation is rapidly transformed into simple excitons and electron-hole pairs. Orig.art.has: 4 figures and 1 table.

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

SUBMITTED: 00/ [illegible]

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

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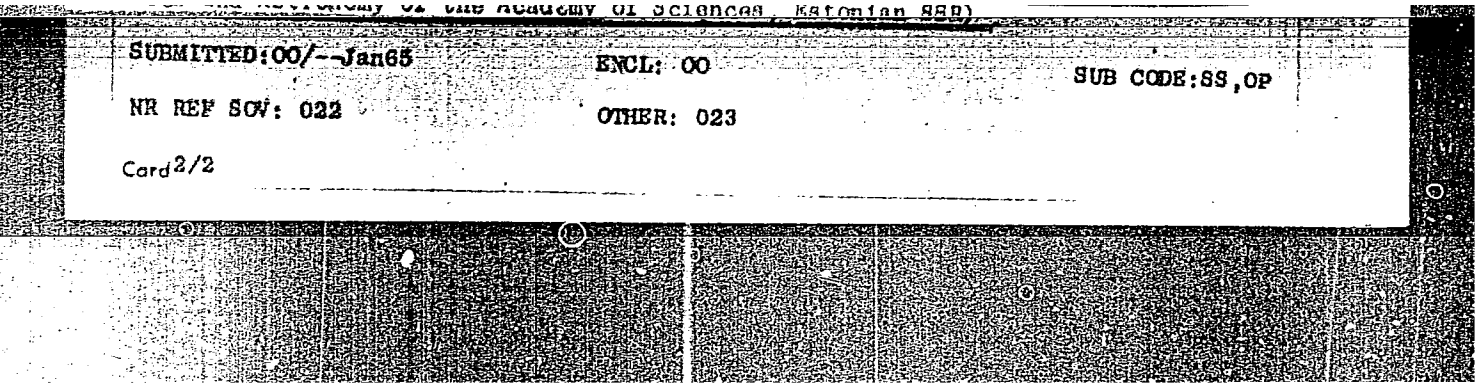

SUBMITTED:00/--Jan65 ENCL: 00 SUB CODE:SS,OP

NR REF SOV: 022 OTHER: 023

Card 2/2

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31
30
G

L 32822-65 EEC(b)-2/EWT(1)/T IJP(c)
ACCESSION NR: AP5004516 S/0048/65/029/001/0036/0039

AUTHOR: Zolotarev, G.K.; Lushchik,Ch.B.; Soovik,T.A.; Yaek,I.V.; Elango, M.A.

TITLE: Self-trapping of holes and optical phenomena in ionic crystals [21] /Report, 12th Conference on Luminescence held in L'vov 30 Jan-5 Feb 1964/

SOURCE: AN SSSR. Izvestiya, Seriya fizicheskaya, v.29, no.1, 1965, 36-39

TOPIC TAGS: luminescence, ionic crystal, recombination luminescence, thermoluminescence, radiation effect, self trapping

ABSTRACT: The authors briefly review recent work in their laboratory concerning the role of hole self-trapping in optical phenomena, and specifically in recombination luminescence, roentgenoluminescence and radiation coloring. The effect of self-trapping in each case is to suppress the phenomenon at low temperatures, where self-trapping occurs. Recombination luminescence is discussed less briefly than the other phenomena and illustrative absorption curves and glow curves are presented. Photoluminescence of KCl:Ag after x-ray radiation at 100°K was found to be very small until the material was heated to above 200°K; thereafter the photoluminescence was large even after subsequent cooling to 100°K. This behavior is explained by the

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ACCESSION NR: AP5004516

thermal release of self-trapped holes which, after migrating to Ag^+ centers, make it possible for recombination luminescence to occur even at low temperatures. An intense thermoluminescence peak was observed for KCl:AgI at 220°K, the radiation of which is characteristic of Ag^+I centers. This radiation is ascribed to recombination of holes with electrons trapped in Ag^+I centers and is regarded as the first convincing case of hole recombination luminescence at activator centers in ionic crystals. Further investigation is desirable to determine whether anion excitons may also become self-trapped in ionic crystals at low temperatures. Orig. art. has: 2 figures.

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

SUBMITTED: 00/--Jan65 ENCL: 00 SUB CODE: SS, OP

NR REF SOV: 006 OTHER: 003

Card 2/2

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 43905-65 EEC(b)-2/EPF(n)-2/EPA(s)-2/EWA(c)/EWT(l)/EWT(m)/EWP(b)/T/EWP(t) Pt-4/
Pt-7/Pu-4 IJP(c) GG/JD/JG

ACCESSION NR: AP5009507 S/0048/65/029/003/0373/0379

AUTHOR: Zazubovich,S.G.; Liyd'ya,G.G.; Lushchik,N.Ye.; Lushchik,Ch.B.

TITLE: Optical structure of luminescence centers in activated ionic crystals /Report, 12th Conference on Luminescence held in L'vov, 30 Jan-Feb 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 3, 1965, 373-379

TOPIC TAGS: luminescence, luminescence polarization, luminescent crystal, luminescence center, alkali halide, single crystal

ABSTRACT: This paper is concerned with the luminescence of alkali halide crystals activated by mercury-like ions. Excitation spectra are presented for the potassium halides activated with indium and tantalum (8 spectra); these spectra cover the photon energy range from 2 to 10 eV. Three principal excitation regions are distinguished: a group of long wavelength bands (the A, B, and C bands); an excitation band adjacent to the fundamental absorption edge (the D band); and an excitation band within the fundamental absorption region. Earlier experimental data, both of the present authors and of others, are adduced, including polariza-

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L 43905-65

ACCESSION NR: AP5009507

tion spectra of the luminescence of KCl activated with Ga, In, Tl, Ge, Sn, and Bi. These data are discussed at some length, and it is concluded that the A, B, and C bands are due to activator excitation and are genetically related to transitions to the $^3P_1$, $^3P_2$, and $^1P_1$ states of the free activator ion, and that the D band is due to excitation of ions of the host, perturbed by neighboring activator ions. Orig. art. has: 3 figures and 1 table.

ASSOCIATION: None

SUBMITTED: 00 ENCL: 00 SUB CODE: OP, SS

NR REF SOV: 017 OTHER: 007

Card 2/2

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 28334-66 EWT(1)/EWT(m)/T/EWP(t)/ETI IJP(c) GG/AT/JD

ACC NR: AP6013073 SOURCE CODE: UR/0048/66/030/004/0654/0660

48
46
B

AUTHOR: Il'mas, E. R.; Lushchik, Ch. B.

ORG: Institute of Physics and Astronomy, Academy of Sciences, EstSSR (Institut fiziki i astronomii Akademii nauk EstSSR)

TITLE: Multiplication of electronic excitations in ionic crystals /Report, Fourteenth Conference on Luminescence held in Riga 16-23 September 1965/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 30, no. 4, 1966, 654-660

TOPIC TAGS: crystal phosphor, semiconductor crystal, current carrier, ionic crystal, pair production, excited electron state

ABSTRACT: Each high-energy photon incident on a solid gives rise to hundreds or thousands of electron-hole pairs and other electronic excitations, which may then be manifested in different forms. The purpose of the present work was to consider the elementary processes of multiplication of electronic excitations (MEE) initiated by a UV photon that produces 2-3 excitations. Primary attention is given to the multiplication mechanism in ionic crystals. The discovery of the effect of production of two carrier pairs by one photon and other early and recent experimental studies are reviewed with numerous references to Soviet and foreign authors. The results of different investigators and the data obtained by the writers are drawn upon for more or less general discussions of photon multiplication resulting in luminescence effi-

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ACC NR: AP6013073

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ciencies exceeding unity (100%), nonlinear effects in pair production, MEE and radiation defects, MEE and photoelectronic emission, MEE in crystals of different classes, the micromechanism of electron-hole pair multiplication, and MEE involving excitons and local excitations. Illustrative energy band diagrams are adduced. In addition to effects in ionic crystals, some phenomena in semiconductors (mainly silicon and germanium) are described. In concluding a suggestion is made for further research. Orig. art. has: 4 figures.

SUB CODE: 20/ SUBM DATE: 00/ ORIG REF: 023/ OTH REF: 020

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

L 28320-66 EWT(1)/T IJP(c) GG/AT

ACC NR: AP6013084 SOURCE CODE: UR/0048/66/030/004/0695/0697

37
AUTHOR: Vale,G.K.; Zolotarev,G.K.; Kuketayev,T.A.; Lushchik,N.Ye; Lushchik,Ch.B. B

ORG: none

TITLE: Activator traps for electrons and holes in ionic crystals /Report, Fourteenth Conference on Luminescence held in Riga 16-23 September 1965/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 30, no. 4, 1966, 695-697

TOPIC TAGS: crystal phosphor, alkali halide, recombination luminescence, ionic crystal, electron trap

ABSTRACT: The stated purpose of the paper is to summarize the results obtained at Tartu (Institute of Physics and Astronomy of the Estonian SSR Academy of Sciences) in studies aimed at elucidating the role of activator ions in formation of electron and hole traps. The basic experimental data were obtained in investigating different alkali halide crystals activated by Ga^+, In^+, Tl^+, Ge^{2+}, Pb^{2+}, Cu^+ and Ag^+ ions. A general discussion of the luminescence centers in such phosphors has been published elsewhere (N.E.Lushchik and Ch.B.Lushchik, Tr. In-ta fiz. i astron. AN EstSSR, No. 6, 5, 1957). It is noted that the character of traps formed by activators is determined primarily by the charge of the activator ion. For example, Bi^{3+} ions are readily reduced to Bi^{2+} and trap an electron in the process. Analogously Ge^{2+}, Sn^{2+} and Pb^{2+} ions in a KCl lattice act as effective electron traps. A number of other cases of

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effective electron trapping are mentioned with references to the papers describing the corresponding investigations. Mention is made of decomposition of atomic centers in ionic crystals, and a table gives the values of the decomposition temperature for atomic Ag, Tl and Cu in different alkali halides. The question is then raised whether activator centers in the same systems are also capable of trapping holes. Recent electron paramagnetic resonance studies and optical experiments indicate that silver at any rate is capable of forming hole traps in alkali halide crystals. Reference is made to other studies and it is concluded that as a rule (and not as an exception) activator luminescence centers in alkali halide crystals are capable of trapping both electrons and holes, so that in many cases in alkali halide crystal phosphors luminescence of activator centers is observed as a result of both recombination of electrons with trapped holes and as a result of recombination of holes with trapped electrons. Orig. art. has: 1 table.

SUB CODE: 20/ SUBM DATE: 00/ ORIG REF: 017/ OTH REF: 003

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

ACC NR: AT7001736 SOURCE CODE: UR/3119/66/000/004/0071/0083

AUTHOR: Il'mas, E. R.; Liyd'ya, G. G.; Lushchik, Ch. B.; Soovik, T. A.

ORG: Institute of Physics and Astronomy, AN EstSSR (Institut fiziki i astronomii AN EstSSR)

TITLE: Photon multiplication in crystals and the phenomenon of radioluminescence

SOURCE: AN LatSSR. Institut fiziki. Radiatsionnaya fizika, no. 4, 1966. Ionnyye kristally (Ionic crystals), 71-83

TOPIC TAGS: photon, radioluminescence, x ray effect, quantum yield, ionic crystal, absorption band, light excitation

ABSTRACT: In connection with their earlier experiments (Opt. i spektr. v. 18, 631, 1965 and elsewhere) dealing with observation and investigation of photon multiplication by crystals in the optical band (rather than x-ray or gamma region), the authors discuss in the present article the connection between this effect and the phenomena of x-ray luminescence and radioluminescence. Particular attention is paid to the role of different electronic excitations of the crystal lattice and to luminescence excited in ionic crystals by hard radiation. Photon multiplication in the optical range was investigated with a special set-up including a vacuum monochromator and a diffraction grating, a high power discharge lamp, a monochromator, a vacuum chamber

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ACC NR: AT7001786

for the samples, and a comparison standard (sodium salicylate) described in the earlier investigation. A number of optical phenomena were investigated in the photon energy range from 5 to 21 eV, particularly the spectra of the quantum yield of stationary photoluminescence of several dozen activated ion crystals. The results show convincingly that photon multiplication in the optical region of the spectrum does exist arises when a single photon produces two electronic excitations in the crystal lattice. The two possible mechaisms for this phenomenon (exciton and electron-hole) are described there and characteristic features are compared with earlier experiments by the authors and by others. It is shown that these two mechanisms operate also in the case of radioluminescence of ionic crystals. A formula is derived for the energy yield of activator luminescence excited in the main absorption bands of a crystal. The possibility of decreasing the time lag of the electron-hole radioluminescence mechanism in scintillating crystals is discussed. As a rule, in stationary radioluminescence the electron-hole mechanism predominates, while in scintillations the two mechanisms are in general on par. In NaI-Tl crystals the electron-hole mechanism apparently predominates. It is shown that a possible reason for the deviation of the real scintillation yield from the estimates presented in the article is the inertia of the electron-hole mechanism. Orig. art. has: 4 figures, 4 formulas, and 1 table.

SUB CODE: 20/ SUBM DATE: 00/ ORIG REF: 022/ OTH REF: 006

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APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

PETROVSKIY, M.I.[Petrovs'kyi, M.I.], dots., otv. red.; GRINOVETS, I.F.[Hrynovets', I.F.], dots., red.; LUSHCHIK, I.O. [Lushchyk, I.O.], dots., red.; MIKHAYLOV, V.I.[Mykhailov, V.I.],dots., red.; PASTER, P.I., red.; TIVONCHUK, I.O. [Tyvonchuk, I.O.], kand. ekon. nauk, red.; YAREMCHISHIN, B.M. [IAremchyshyn, B.M.], st. nauchn. sotr., red.; YAKIMTSOV, P.P., dots., red.; GRINSHPON, F.O.[Hrinshpon, F.O.], red.; KVITKO, I.S., red.

[Flourishing of the economy of the western provinces of the Ukrainian S.S.R., 1939-1964] Rozkvit ekonomiky zakhidnykh oblastei URSR (1939-1964 rr., L'viv, 1964. 126 p. (MIRA 17:11)

1. L'vov. Universytet.

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

PETROVSKIY, M.I.[Petrovs'kyi, M.I.], otv. red.; LUSHCHIK, I.O. [Lushchyk, I.O.], dots., red.; PETROV, V.S., dots., red.; KVITKO, I.S., red.

[Material incentives and technological progress] Material'ne stymuliuvannia i tekhnichnyi progres. L'viv, Vyd-vo L'vivs'kogo univ., 1964. 126 p. (MIRA 18:8)

1. L'vov. Universytet. Kafedra politychnoi ekonomii.

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, K.I.

Our method for magnetizing magnets in the relays of centralized traffic control systems. Avtom., telem. i sviaz' 9 no.10:28-29 O '65. (MIRA 18:11)

1. Starshiy inzh. kontrol'no-ispytatel'nogo punkta Sal'skoy distantsii Severo-Kavkazskoy dorogi.

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, K.I.

Protection of frequency-type dispatcher interlocking equipment from atmospheric overvoltages. Avtom., telem. i sviaz' 9 no.3:32-33 Mr '65. (MIRA 18:11)

1. Starshiy inzh. laboratorii kontrol'no-izmeritel'nykh priborov Sal'skogo otdeleniya Severo-Kavkazskoy dorogi.

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, N.

Current problems in the study of economics by trade-union activist groups. Sov.profsoiuzy 17 no.4:23-25 F '61. (MIRA 14:2)

1. Zaveduyushchiy lektorskoy gruppoy Moskovskogo gorodskogo soveta profsoyuzov.
(Moscow—Economics—Study and teaching)
(Moscow—Trade unions)

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, Ch.; LUSHCHIK, N.

Regularities of fluorescence in activated ionic crystals.
Acta physica Pol 26 no.3/4:711-717 S-O '64.

1. Institute of Physics and Astronomy of the Academy of Sciences of the Estonian S.S.R., Tartu.

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, N.

"Alkali halide phosphors activated with indium."

p. 149 (Uurimused. Trudy) No. 6, 1957
Tartu, Estonia

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

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

24(2), 24(7) SOV/48-22-11-16/33

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" $\varrho = E_g/E_k > 1$, 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 3). It appeared that approximately $\varrho = 1 + aE_g$ (Ref 3). 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

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(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.

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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)

Card 4/4

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, N. Ye., Candidate Phys-Math Sci (diss) -- "Investigation of centers of luminescense in alkali-halogen crystal phsphors activated by mercury-like ions: Ga^{+}, In^{+}, Tl^{+}, Ge^{++}, Sn^{++}, Pb^{++}". Tartu, 1959. 12 pp (Tartu State U) 225 copies (KL, No 25, 1959, 126)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

LUSHCHIK, N.Ye., otv. red.

[Materials of the 7th Conference on Luminescence (crystallophosphorescence), held at Moscow, June 26 to July 3, 1958]Materialy VII Soveshchaniia po liuminestsentsii (kristallofosfory), Moskva, 26 iiunia - 3 iiulia 1958 g. Tartu, Akad. nauk Estonskoi SSR, 1959. 390 p. (MIRA 15:9)

1. Soveshchaniye po lyuminestsentsii. 7th, Moscow, 1958. (Phosphorescence--Congresses)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

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

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

Ch. B. Lushchik, I. W. Jack, G. G. Lüdja, 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.

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

24, 3500 (1137, 1138, 1395)

23334 S/058/61/000/006/020/063
A001/A101

AUTHORS: Lushchik, N.Ye., Zazubovich, S.G.

TITLE: The spectroscopy of impurity centers in alkali-halide crystals activated by noble metal ions

PERIODICAL: Referativnyy zhurnal, Fizika, no. 6, 1961, 164-165, abstract 6V223 ("Tr. In-ta fiz. i astron. AN EstSSR", 1960, no. 12, 267 - 270)

TEXT: Spectral characteristics of KCl and KBr single crystals activated by Cu, Ag and Au were investigated. The following spectra of absorption, excitation and emission were obtained: KBr-Cu (100°K), KBr-Ag (100°K), KBr-Au (300°K). In comparison with spectra of phosphors based on KCl, the spectra of KBr-Ag are displaced towards longer wavelengths. A conclusion was drawn from the comparison of impurity center characteristics in crystals and free noble ions: luminescence centers in crystals are ions of Cu^+, Ag^+, Au^+, interacting with the proximate surrounding of the crystalline lattice. Electronic state of noble ions and their interaction with the crystal, change at absorption and emission of light by the centers. It has been found out that main bands of activator absorption correspond to transitions $nd^{10} \rightarrow nd^9 (n+1)p$.

N. Maksimova

[Abstracter's note: Complete translation]

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

increase of E_f:

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

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.

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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

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

S/613/61/000/014/007/019
D207/D303

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

TITLE: Spectroscopy of luminescence centers in ionic crystals activated with noble ions (Cu^+, Ag^+, Au^+)

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy. No. 14, 1961. Issledovaniya po lyuminestsentsii, 141-167

TEXT: The authors investigated the absorption and luminescence spectra of KBr, KCl and NaCl activated with Cu, Ag and Au. Comparison of the energy structure of luminescence centers in the phosphors with the structure of free Cu^+, Ag^+, Au^+ ions gave information on the nature of these centers. Phosphor monocrystals were prepared either by the Kyropoulos method or by method of diffusion of the activator from gaseous phase. The initial materials were KBr of analytic purity, KCl of special and chemical purities, and NaCl of spectroscopic and chemical purities. AgBr, $AgNo_3$, CuCl and

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Spectroscopy of luminescence ...

$HAuCl_4$ were used to activate the alkali halides. The phosphors formed unstable solid solutions with their activators and, therefore, KBr:Cu, KCl:Cu and KBr:Au were quenched after heating to 400°C, while KBr:Ag, KCl:Ag and KCl:Au were quenched after heating to 600°C. Absorption spectra were recorded with a spectrophotometer СФ-4 (SF-4). Emission and excitation spectra were obtained with two SF-4 instruments, one of which was used to select the required emission or excitation wavelengths. Low-temperature measurements were carried out in a metal cryostat, in which temperature could be varied continuously from 100 to 500°K. The authors examined the activator distribution in the phosphors using a microscope МБИ(MBI) and a dark field condenser. They also compared the phosphor absorption, excitation and emission spectra with the energy level structure of free Cu^+, Ag^+ and Au^+ ions. The results indicated that the luminescence centers were mainly single Cu^+, Ag^+ and Au^+ ions (type I centers). There were also some centers (type II) composed of these ions associated with crystal defects, such as vacancies

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Spectroscopy of luminescence ...

or dislocations. The nature of type I centers was firmly established, but further work is needed on type II centers. Acknowledgment is made to Ch. B. Lushchik for suggesting the subject and directing the work and to R. I. Gindina for help in microscopic measurements. There are 16 figures and 43 references: 29 Soviet-bloc and 14 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: D. Barber, K. Harvey and J. Mitchell, Phil. Mag., 2, 704 (1957); H. Etzel and J. Schulman, J. Chem. Phys., 22, 1549 (1954); R. Knox, Phys. Rev., 115, 1095 (1959); Y. Uchida and R. Kato, J. Phys. Soc. Japan, 14, 1408 (1959).

SUBMITTED: July 29, 1960

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

S/613/61/000/014/016/019
D207/D303

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

TITLE: Luminescence spectra of centers in crystals activated by isoelectronic ions

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy. No. 14, 1961. Issledovaniya po lyuminestsentsii, 283-285

TEXT: The authors studied emission and excitation spectra of luminescence of KCl:Tl, KCl:Pb and KCl:Bi phosphors in order to find the effect of change from free to bound state on the transition energies of activator ions. KCl:Tl (0.03 mol.% Tl in melt) and KCl:Pb (0.5 mol.% Pb in melt) were grown by the Kyropoulos method. KCl:Bi (0.01 mol.% Bi in melt) was prepared by the Stockbarger-Shamovskiy method in evacuated sealed quartz ampoules. Excitation and emission spectra showed that in KCl phosphors the $^1S_0 \rightarrow {}^3P_1$ vibronic (electronic-vibrational) transition energies decrease

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Luminescence spectra of ...

along the series Tl^{+} - Pb^{2+} - Bi^{3+} in contrast to free ions where this energy increases from Tl to Bi. Energies of purely electronic transitions behave in a similar way. This decrease of the transition energies is governed primarily by the activator ion charge and, to a much lesser extent, by the type of the ion. It is known that KCl phosphors activated with the isoelectronic ions In^{+}, Sn^{2+} and Sb^{3+} behave in the same way. A theoretical explanation of these observations is to be published by N. N. Kristofel' (Trudy IFA AN ESSR, no. 15, 1961 - in print). It is intended to follow up the present note with a more detailed communication. There are 1 figure and 7 references: 5 Soviet-bloc and 2 non-Soviet-bloc. The reference to the English-language publication reads as follows: A. Glasner and R. Reisfeld, J. Chem. Phys., 32, 956 (1960).

SUBMITTED: February 20, 1961

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APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7"

"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

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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Polarized luminescence ...

tion is due to $^1S_0 \rightarrow {}^3P_1$ transitions. The high degree of polarization of KCl:Bi luminescence was due to point defects next to Bi^{3+} ions which impede reorientation of P electron-density "dumb-bells" along C_4 axes. After X-ray radiation of KCl:Bi, the number of Bi^{3+} centers was found to be strongly reduced. Simultaneously new activator centers, Bi^{2+}, appeared in the phosphor. The excitation spectrum of the new centers was peaked in the region of 4.25 eV and the emission band had a maximum at 2.9 eV. Luminescence of Bi^{2+} centers was practically unpolarized; this is in agreement with the absence of polarization of luminescence due to $^2S_{1/2}$ $^2P_{1/2}$ transitions in free Bi^{2+} ions. Detailed results will be published later. There are 4 Soviet-bloc references.

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24.7500,

S/058/62/000/008/046/134
A061/A101

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

TITLE: Electron-vibrating processes in the luminescence centers of ionic crystals with the participation of some excited states

PERIODICAL: Referativnyy zhurnal, Fizika, no. 8, 1962, 43, abstract 8V299 ("Tr. In-ta fiz. i astron. AN EstSSR", 1961, no. 15, 30 - 55; summary in English)

JA

TEXT: The dependence of spectra and quantum yield of luminescence in KCl-In, KBr-In, KBr-Ga, KBr-Sn, KBr-Tl, KBr-Pb, and KI-Tl phosphors on the frequency of exciting light has been investigated at 100 and 295°K. Emission spectra of impurity centers in crystals and of free mercury-like ions are compared in detail. The mechanism of nonradiative $^1P_1 \rightarrow {}^3P$ transitions and the effect of "agitation" of electronic states in luminescence centers are discussed. There are 28 references.

[Abstracter's note: Complete translation]

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32385

S/613/61/000/017/003/011
D051/D113

24.3500 (1137, 1138, 1163)

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

TITLE: Polarization characteristics of some alkali halide crystal phosphors

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy, no. 17, 1961. Issledovaniya po lyuminestsentsii, 38-49

TEXT: The polarization characteristics of the luminescence of alkali halide crystals activated by mercury-like (Ga^+, In^+, Tl^+, Pb^{++}, Bi^{+++}) and noble (Cu^+, Ag^+, Au^+) ions were investigated. The study was conducted so as to explain how far activator ions interact with different types of crystal defects and whether these defects spread to luminescence centers whose "core" is composed of mercury-like and noble ions. The polarization method employed was developed by P.P.Feofilov who used it to reveal the anisotropy of colored centers and luminescence centers established by rare earth ions

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in certain metal fluorides. It was shown that the emission of the main luminescence centers at 293° K is not polarized in most phosphors. The luminescence centers in KCl-Bi and NaCl-Ag phosphors reveal a strong polarization of luminescence. Azimuthal dependences of the degree of polarization show that the oscillators are oriented along the C_4 axes. It is doubtful whether such an orientation testifies to an anion defect near the activator. The polarization diagram of KCl-Bi corresponds to that of absorption and emission by electric linear oscillators. The polarization spectra of KCl-Bi, NaCl-Ag, KCl-Tl, and NaCl-Tl were investigated and discussed. There are 6 figures. The most important English-language reference is: C.Click, W.Compton, Phys.Chem. Solids, 7, 170, 1958;

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D051/D113

24.3500 (1137, 1138, 1163)

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

TITLE: Alkali halide phosphors activated by bismuth and antimony

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy, no. 17, 1961. Issledovaniya po lyuminestsentsii, 50-66

TEXT: The study was conducted so as to obtain and examine spectroscopically alkali halide crystals activated by bismuth and antimony. The principles governing the preparation of the phosphors were: small activator concentrations and high temperatures for obtaining solid solutions of $KCl \cdot BiCl_3$ and $KCl \cdot SbCl_3$ systems, quick cooling of the systems in order to oversaturate the solid solutions, increase in the solubility of the trivalent activators by simultaneously introducing bivalent negative ions (e.g. S^{2-}) intended to compensate the excess positive charge of the activator ions. On this basis, the single-crystal phosphors KCl-Bi, NaCl-Bi, KBr-Bi and the phosphor KCl-Sb were obtained, using for the Bi-phosphors the Stokbarger-Shamovskiy method

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Alkali halide phosphors ...

of single-crystal growth (L.M.Shamovskiy, L.M.Rodionova, A.S.Glushkova, Izv. AN SSSR, ser.fizich., 22,3,1958). It was found that the luminescence centers in KCl-Bl are Bi^{3+} ions which are effective trapping centers for electrons. The Sb-activated phosphors showed complex luminescence center structure. The regularities in the spectra of KCl crystals activated by the isoelectronic ions Tl^{+}, Pb^{2+}, Bi^{3+} and In^{+}, Sn^{2+}, Sb^{3+} are discussed. Ch.B.Lushchik and E.S.Tiisler are thanked for help rendered. There are 10 figures. The most important English-language reference is: A.Douglas, D.Hartree, W.Runciman, Proc.Roy.Soc., 51, 486, 1955.

SUBMITTED: April 27, 1961

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"APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R001030920009-7

S/613/61/000/017/005/011
D051/D113

24.3500 (1137, 1138, 1163)

AUTHORS: Lushchik, N.Ye. and Muuga, I.A.

TITLE: The spectroscopy of crystals activated by mercury-like ions. II. Calcium orthophosphate phosphors

SOURCE: Akademiya nauk Estonskoy SSR. Institut fiziki i astronomii. Trudy, no. 17, 1961. Issledovaniya po lyuminestsentsii, 67-86.

TEXT: This paper is a continuation of investigations of the spectral characteristics of alkali halide crystals activated by mercury-like ions, which were conducted by Ch.B.Lushchik and N.Ye.Lushchik from 1955 to 1960. The present work describes the simple laboratorial method of preparation and the spectral features of a group of phosphors based on $Ca_3(PO_4)_2$ and activated by mercury-like ions. Calcium orthophosphate phosphors were studied because of the need for economy in cheap luminophores suitable as spectral transformers in luminescent lamps of ultraviolet emission (λ = 253.7; 185 mμ). The results of the study were satisfactory. The excitation and

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The spectroscopy ...

emission spectra of the impurity centers were measured at 293° and 100° K and compared with the spectral characteristics of free Ga^{+}, Ge^{++}, In^{+}, Sn^{++}, Tl^{+} and Pb^{++} ions. The comparison permitted interpreting the electron structure of the spectra of the studied phosphors. A.V.Moskin, F.M.Pekerman, A.V.Morozova, E.Männik, and L.I.Karaseva are thanked for help rendered. There are 7 figures and 1 table. The most important English-language reference is: K.Butler, J.Electrochem.Soc., 100,250, 1953.

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LUSHCHIK, Ch.B.; LIYD'YA, G.G.; LUSHCHIK, N.Ye.; SHVARTS, K.K.; YAEK, I.V.

Physical processes in alkali halide crystal phosphors activated by mercury-like ions. Fiz.tver.tela 3 no.4:1176-1184 Ap '61. (MIRA 14:4)

1. Institut fiziki i astronomii AN Estonskoy SSR, Tartu.
(Phosphors)

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