

Particularities of Formation Defects in the Ammonium Halide Crystals with Impurity of Mercury Like Ions

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In Fig. 1 are shown spectrums of the additional absorption irradiated crystal under $T = 80$ and $T = 300$ K. Exist four intensive bands of the absorption NH_4Cl-Sn^{2+} under 4.0, 3.75, 3.65 and 3.45 eV. These bands thermal stable up to $T = 340-360$ K. Like thermal stability of the directed bands of the absorption does not correspond to creation $Sn^{2+}V_c^-$ or Sn^{3+} -a centre. At excitement in band of the additional absorption of NH_4Cl-Sn^{2+} exists of phosphorescence with maximum under 3.0 eV and half width 0.2 eV (Fig. 2). The band 2.40 eV, observed luminescence in spectrum of nonirradiation crystals, is connected with electronic-oscillatory transition $^3P_1 \rightarrow ^1S_0$ in ion of Sn^{2+} . The phosphorescence 3.0 eV quickly fades and after phase transition under $T = 235$ K to practically does not exist.

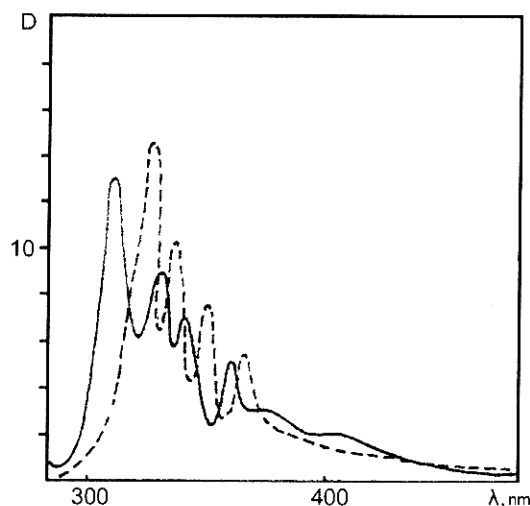


Fig. 1. Spectrums of the directed absorption irradiated crystal NH_4Cl-Sn^{2+} (···) $T=80$ K, (---) $T=300$ K

The ions Sn^{2+} have a smaller relationship to electron in contrast with Yb^{2+} . This condition the sharp difference in mechanism of radiation point NH_4Cl-Sn^{2+} and NH_4Cl-Yb^{2+} . The ion NH_4^+ becomes in the NH_4Cl-Sn^{2+} main centre of the seizure electron, which is converted in NH_3^0 . Being situated near by Sn^{2+} , ammonia on the one hand compensates the surplus charge, with other – forms the molecular relationship with Sn^{2+} . Electronic transition in molecule $Sn^{2+}NH_3^0$ give the observed bands of the absorption. Since NH_3^0

presents itself firm molecule, the temperature of the destruction $Sn^{2+}NH_3^0$ – a centre turns out to be high.

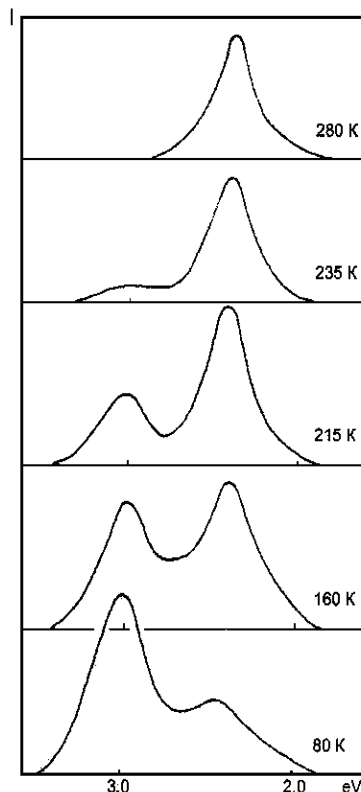


Fig. 2. Spectrums x-ray luminescence of NH_4Cl-Sn^{2+} under different temperature

In Fig. 3 are shown spectrums of the directed absorption in crystal NH_4Cl-Pb^{2+} under 80 and 300 K. Under $T = 80$ K bands of the absorption exist to 3.95, 3.70, 3.50 and 3.27 eV. Under $T = 300$ K maximums of these bands are displaced in long wave area. The number and structure of the bands of the absorption in irradiated crystal NH_4Cl-Pb^{2+} similar directed absorption NH_4Cl-Sn^{2+} . In spectrum of x-ray luminescence also appears the short-wave band, which quickly fades with increasing of the temperature. The Absorption directed centre of the colouration in NH_4Cl-Pb^{2+} lies in more long wave area in contrast with NH_4Cl-Sn^{2+} . Bands of the absorption thermal stable before $T = 340-360$ K.

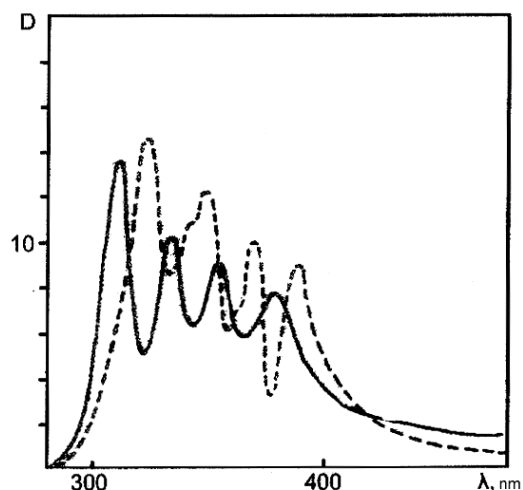


Fig. 3. Spectrums of the directed absorption irradiated crystal NH_4Cl-Pb^{2+} (—) $T=80$ K, (---) $T=300$ K

In this case structure of the centre of the colouration in NH_4Cl-Pb^{2+} similar such in NH_4Cl-Sn^{2+} , i.e. presents itself cluster from ion Pb^{2+} with located beside by molecule of ammonia NH_3^0 .

Quick fading the short-wave band to luminescences in irradiated crystal NH_4Cl-Sn and NH_4Cl-Pb is connected with big efficiency nonradiative degradation to energy of excitement. Really, presence near by Pb^{2+} and Sn^{2+} molecules NH_3^0 brings about big nucleus offsets under electronic transition that lowers the activated barrier between agitated and the main conditions admixture. In alkali halides with impurity of the Tl^+ - ion after irradiation appear the defect centre of the colouration of the type Tl^0 and Tl^{++} .

Considering strong resemblance optical spectrum Tl^+ - a centre in alkali halides and ammonium halides [1], possible was expect finding the directed bands of the absorption in ammonium halides with impurity ion. However called on by us careful measurements spectrum absorptions, spectrum of excitement phosphorescence irradiated ammonium halides with different concentration impurity ion thallium did not give

the positive result. The Directed bands of the type centre absorption Tl^0 or Tl^{++} is discovered was not. This will with result of the measurements EPR spectrum on actuated thallium crystal NH_4Cl [2].

Such result is greatly distinguished from result for alkali halides and is connected with ion NH_4^+ . The section of the seizure electron by ion NH_4^+ turns out to be well over, than beside that brings about small efficiency of the formation Tl^0 -a centre. The holes, in turn, with big probability (up to the temperature 200 K) are seized NH_3^0 with formation NH_3^+ and hereinafter centre NH_3Hal , which gives both optical absorption, and in spectrum EPR [2]. A part of holes under low temperature (under $T < 130$ K) self trapped, a certain part is seized by ion of the halogen with formation interstitial atom of the halogen.

Thereby, formation centre Tl^{++} - type also unlikely. Forming the firm molecules $Tl^+NH_3^0$ basically condition is limited in consequence of s-type molecular orbital main condition. However already in undermost the agitated condition Tl^+ can form linking orbital sp-type with molecule NH_3^0 . Herewith appears the long wave band in spectrum phosphorescence of ammonium halides with impurity of Tl^+ .

Thereby, in actuated bivalent ion Sn^{2+} and Pb^{2+} of ammonium halides formation electronic centre seizure unlikely, because of small relationship to electron these ion and small section of the seizure in contrast with corresponding to section of NH_4^+ beside. The main role in radiated coloration in this case, play the centres of the $Me^{2+}NH_3^0$ ($Me^{2+}=Sn^{2+}, Pb^{2+}$) type.

In actuated of Tl^+ - ion of ammonium halides directed defect centre of the colouration is not discovered that links with small section of the seizure of the Tl^+ - ion both electron, and holes.

References

- [1] Jurov V.M. Vestnik the Karaganda state university. Physics, 4(40). pp.21–30 (2005).
- [2] Vannoti L., Zeller H.R., Bachman K., Känzig W. Phys. Kondens. Materie, 1967, Bd.6, pp.11–51.