# PECULIARITIES OF $Cs_{1-x}Rb_xCu_2Cl_3$ SOLID SOLUTIONS ABSORPYION SPECTRA

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Peculiarities and characteristics of absorption spectra $Cs_{1-x}Rb_xCu_2Cl_3$ solid solutions have been studied in this work. Many complex compounds related to this system have high ionic conductivity and are classified as solid electrolytes [1,2], some of them can be decent luminophores [3] and can be used in light-emitting devices. The absorption spectra of thin films of $CsCu_2Cl_3$ and $RbCu_2Cl_3$ are isostructural and are close by spectral position of the bands [1]. The exciton spectrum of both compounds is interpreted on the basis of transitions in the $Cu^+$ ion.

Thin films for investigation were prepared by vacuum evaporation of a melt mixture of pure CuCl, CsCl and RbCl. Then the films were annealed for an hour at 100°C.

In the concentration range $0\le x\le 0.6$, the absorption spectra of $Cs_{1-x}Rb_xCu_2Cl_3$ thin films are similar in the structure of the spectrum and close in the spectral position of the absorption bands (Fig. 1a). As x increases, the A and B exciton bands slightly linearly shift to the short-wavelength region of the spectrum with $dE_m/dx=0.03$ eV and 0.045 eV, respectively. In the range $0.6<x\le 1$, on the contrary, a noticeable linear long-wavelength shift of the A and B exciton bands is observed with increasing x with $dE_m/dx = -0.43$ eV and $-0.59$ eV. The half-width $\Gamma(x)$ of the exciton bands A and B (Fig. 1b) slightly linearly increases in the range $0\le x\le 0.6$ with $d\Gamma_A/dx=0.05$ eV and $d\Gamma_B/dx=0.049$ eV. In the interval $0.6<x\le 1$, the half-width $\Gamma(x)$ increases with $d\Gamma_A/dx=0.19$ eV and $d\Gamma_B/dx=0.185$ eV.

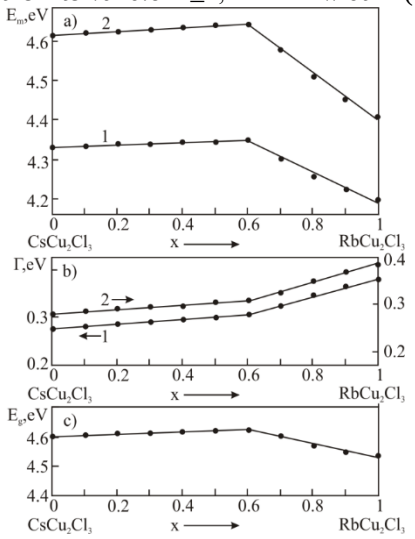


Fig. 1. The concentration dependences of the spectral position $E_m(x)$ (a), half-width $\Gamma(x)$ (b) of the long-wavelength exciton bands A(1) and B(2) and the bandgap width $E_g$ (x) (c).

We assume that the presence of two concentration intervals with different concentration behavior of $E_m(x)$ and $\Gamma(x)$ of the exciton A and B bands is due to the different crystal structure of the $Cs_{1-x}Rb_xCu_2Cl_3$ compounds in the intervals $0\le x\le 0.6$ and $0.6<x\le 1$. In the first concentration range, apparently, the $Cs_{1-x}Rb_xCu_2Cl_3$ solid solutions are isostructural with $CsCu_2Cl_3$, since their exciton spectra are similar by structure and close in the spectral position of the bands. A slight short-wavelength shift of the A and B bands in the range $0\le x\le 0.6$ indicates a slight increase in the ionicity of the compounds and the bandgap width $E_g$. In this concentration range $E_g(x)$ grows linearly (Fig. 1c) according to equation $E_g(x)=E_g(0)+ax$, where $E_g(0)=4.605\pm0.001$ eV, $a=dE_g/dx=0.03\pm0.003$ eV .

In the range $0.6<x\le 1$ solid solutions $Cs_{1-x}Rb_xCu_2Cl_3$ are isostructural with $RbCu_2Cl_3$. A significant long-wavelength shift of the spectral position $E_m(x)$ of the A and B exciton bands in this concentration range indicates a decrease in the ionicity of the $Cs_{1-x}Rb_xCu_2Cl_3$ solid solutions. In this concentration range, the bandgap width $E_g(x)$ decreases linearly (Fig. 1c) from $dE_g/dx= -0.23$ eV. The linear concentration dependences of the bandgap width $E_g(x)$, spectral position $E_m(x)$ and half-width $\Gamma(x)$ of exciton bands in $Cs_{1-x}Rb_xCu_2Cl_3$ solid solutions confirm the localization of excitons in the sublattice of compounds that contains $Cu^+$ ions.

**Keywords:** solid solutions, thin films, absorption spectra, excitons

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