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Absorption spectra of $Rb_{3x}Cs_{3-3x}Cu_2I_5$ solid solutions

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Thin films of $Rb_3Cu_2I_5$ ternary compound and $Rb_{3x}Cs_{3-3x}Cu_2I_5$ solid solutions have been synthesized for the first time and theirs absorption spectra at 90 K have been studied. The concentration dependences of *1s* exciton band parameters (spectral position E_m, half-width Γ, forbidden gap E_g) are linear thus evidencing a weak effect of small-scale fluctuations in the solid solution composition of the absorption spectrum and the exciton localization in the CuI-sublattice. The Davydov splitting of exciton bands has been found due to the exciton transfer between non-equivalent CuI_4^{3-} tetrahedrons in double chains.

Впервые синтезированы тонкие пленки тройного соединения $Rb_3Cu_2I_5$ и твердых растворов $Rb_{3x}Cs_{3-3x}Cu_2I_5$ и исследован их спектр поглощения при 90 К. Концентрационная зависимость параметров *1s*-экситонных полос (спектрального положения E_m, полуширины Γ, ширины запрещенной зоны E_g) имеет линейный характер, что указывает на слабое влияние мелкомасштабных флуктуаций состава твердых растворов на их спектр поглощения и свидетельствует о локализации экситонов в CuI-подрешетке. Обнаружено давыдовское расщепление экситонных полос за счет переноса экситонов между неэквивалентными тетраэдрами CuI_4^{3-} в двойных цепях.

The former studies of RbI–CuI alloys phase diagrams have shown complex ternary compounds Rb_2CuI_3 and $RbCu_2I_3$ to be formed in that system [1] whereas $Cs_3Cu_2I_5$ and $CsCu_2I_3$ compounds have been found in CsI–CuI system [2]. The electron absorption spectra of thin films of CuI–RbI alloys at the CuI molar concentrations $y = 0.33$ and $y = 0.67$ answering to compounds indicated in [1] were studied in [3] while those of CsI–CuI ones at $y = 0.4$ and $y = 0.67$, in [4]. $RbCu_2I_3$ and $CsCu_2I_3$ are iso-structural compounds and have very similar crystal lattice parameters [2, 5] and rather similar absorption spectra [3, 4]; this is evidences also by spectra of their solid solutions [6]. At the same time, the absorption spectrum of the assumed Rb_2CuI_3 ($y = 0.33$) is similar to that of $Cs_3Cu_2I_5$ in its structure and spectral positions of main exciton bands and differs considerably from that of the close compound Rb_2AgI_3 [7]. These facts give rise to doubts in the Rb_2CuI_3 existence and allow to suppose that in fact, the absorption spectrum of $Rb_3Cu_2I_5$ containing excess RbI is shown in [3]. The existence of $Rb_3Cu_2I_5$ isostructural to $Cs_3Cu_2I_5$ is mentioned in [5] but the compound was not obtained in its pure form.

To solve the problem of complex compounds existence in the RbI–CuI system, we have studied the absorption spectra of the films within the concentration range $0.3 \le y \le 0.4$ and their electron diffraction patterns (EDP); spectra of $Rb_{3x}Cs_{3-3x}Cu_2I_5$ solid solutions have been studied as well.

The thin films were prepared by in vacuo thermal evaporation of CuI and RbI mix-