**INTRODUCTION**

Cadmium halogenides are widely used as radiation detectors. The lattices of these complicated crystals are strongly anisotropic. The CdBr$_2$ structure is of the CdCl$_2$ type, namely, the rhombic lattice with $D_{3d}^5$ symmetry. In the case of a compound of this type, it is difficult to obtain a cut parallel to the $c$ axis. Therefore, in the case of CdBr$_2$, only spectra of cuts for $E \perp c$ polarization are known in a broad energy range. Synchrotron reflectivity spectra were measured at 35 K in the energy range 3–30 eV in [1]. In addition, the reflectivity spectra in a narrow energy range 4–10 eV [2] and the spectra of characteristic losses were studied experimentally [3]. However, it is necessary to know ten or more optical functions of the complete set to analyze the properties of this crystal thoroughly and precisely [4]. Thus, the aim of this paper is to obtain the spectra of the complete set of CdBr$_2$ optical functions at 35 K in the energy range 3–30 eV are obtained using experimental reflectivity spectra and the Kramers–Kronig relations. The main features of the structures of the optical spectra, including the energies of volume and surface losses, are determined. The results of an analysis of the effective number of electrons participating in transitions are presented.

**RESULTS AND DISCUSSION**

The experimental spectra of the reflectivity $R$, the real part $\varepsilon_1$ of permittivity, and the refractive index $n$ are shown in Fig. 1a. We were able to single out 23 maxima and steps in the spectrum $R(E)$ (see the table). The spectra $\varepsilon_1(E)$ and $n(E)$ contain analogs of all these structures, except two weak steps in the energy range 20–23 eV. In this case, the band maxima in the spectra of $\varepsilon_1$ and $n$ are shifted by 0.05–0.4 eV for $\varepsilon_1$ and by 0.03–0.3 eV for $n(E)$ toward lower energies. All bands can easily be divided into four groups. The first group in the interval 5–10 eV contains six narrow, very intense peaks. In this case, the intensities of the analogs of the most intense peaks in $R(E)$ (nos. 5–7) are lower in the spectra of $\varepsilon_1$ and $n$ and become noticeably weaker than band nos. 1–4. The second group of bands in the interval 10–15 eV has a complicated structure consisting of narrow peak no. 13 and several weaker maxima and steps in the spectrum $R(E)$. A sharp decrease in the intensity of higher energy bands can be observed in the spectra $\varepsilon_1(E)$ and $n(E)$ just as for the first group. The third group consisting of four relatively weak bands is located in the interval 15–17 eV. The fourth portion of the spectrum for $E > 17$ eV can be characterized by the presence of very weak bands.

The spectra of the imaginary part $\varepsilon_2$ of permittivity, the index $k$ of absorption, the absorption coefficient $\alpha$, and the function $\varepsilon_2 E^2$ (equal to the joint density of states up to a constant factor) have similar structures and contain analogs of all features of the spectrum $R(E)$ (Fig. 1b). The intensities of the bands in the spectrum $\varepsilon_2(E)$ decrease noticeably in the interval $E > 8$ eV, and only bands nos. 11–13 are relatively intense. As in the spectrum $R(E)$, band no. 5 is most intense; its intensity is greater than the intensities of the other bands by a factor of 2 or more. This discrepancy is considerably less pronounced in the spectra of $k$, $\alpha$, and $\varepsilon_2 E^2$. In addition, the bands in the spectra $\alpha(E)$ and $\varepsilon_2 E^2$ in the energy range 8–30 eV remain very intense even compared to the peaks in the energy range 5–8 eV.

The functions of volume characteristic losses $-\text{Im}\varepsilon^{-1}$ usually contain only one very broad and intense band in the energy range 15–30 eV and several weak bands in other energy ranges.

It is usually assumed that the most intense band is due to the excitation of bulk plasmons and that the other bands are due to interband or exciton transitions. A very
Fig. 1. Spectra of the CdBr\textsubscript{2} crystal: (a) (1) the experimental spectrum $R(E)$ given in [1] and the calculated spectra of (2) $\varepsilon_1$ and (3) $n$; (b) the calculated spectra of (1) $\varepsilon_2$, (2) $k$, and (3) $\alpha$, and (4) $\varepsilon_2 E^2$; (c) the calculated spectra of (1) $-\text{Im}\varepsilon^{-1}$, (2) $-\text{Im}(1 + \varepsilon)^{-1}$, and (3) $n_{\text{eff}}$; and (d) the spectra of $n_{\text{eff}}$ calculated using (1) $\varepsilon_2$, (2) $k$, (3) $-\text{Im}\varepsilon^{-1}$, and (4) $-\text{Im}(1 + \varepsilon)^{-1}$. 