

Nanooptics and photonics

The theory of absorption and emission of light by free electrons in semiconductors

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To the last time there was not any a modern theory of light absorption and emission by free carriers in semiconductors. There were only separate papers that touched the features of absorption and emission of light in a multivalley [1] and ferromagnetic [2] semiconductors. In this paper a general theory of the light absorption and emission by free carriers in semiconductors including multivalley and ferromagnetic semiconductors (FMSC) was carry out. General expressions are obtained for the coefficient of light absorption by free carriers as well as the intensity of the spontaneous light emission by hot electrons in multivalley semiconductors. These expression depend on the electron concentration and electron temperature in the individual valleys. An anisotropy of the dispersion law and electron scattering mechanism is taken into account. Impurity-related and acoustic scattering mechanisms are analyzed. Polarization dependence of the spontaneous emission by hot electrons is found out. General expressions are got for an asorptance, and at presence of hot electrons, and for intensity of scattering light by free electrons in FMSC for a case, when dominant is electron-magnon interaction, in that dependence is taken into account on the concentration of electrons, their temperature and magnon temperature. The classic and quantum cases are considered. It is shown that in the classic range of frequencies, if there is not a warming-up of electrons and magnon, an asorptance by the free electrons of light in FMSC only on a multiplier differs from the classic formula of Dryde. It is set that intensity of spontaneous radiation of hot electrons in FMSC does not depend on frequency of light in the classic range of frequencies and exponentially falls in the quantum area of frequencies.

1. *Tomchuk P.M.* Peculiarities of the light absorption and emission by free electrons in multivalley semicoinductors // Ukrainian journal of physics – 2004. – V.49, №7. – P. 682-691.
2. *Semchuk O.Yu.* The peculiarity of absorption and emission of light by free electrons in ferromagnetic semiconductors // Surface. – 2016. – P.3-13.