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LIGHT ABSORPTION BY SEMICONDUCTORS

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ABSTRACT
In given article has been expressed solids, free carriers during their motion continuously experience collisions with atoms and ions of impurities and various defects, as a result, free carriers scatter as well.
KEY WORDS: *semiconductor, conductivity, source, ion, experience, atoms.*

INTRODUCTION

The electrical and optical properties of semiconductors are related to the fact that the energy levels filled with electrons in the valence band are separated from the conduction band by a forbidden band. Accordingly, a quantum approach should be used, considering light as a stream of photons with energy.

Semiconductors have a low concentration of free electrons, and if the energy of a light quantum is less than the band gap (<E), then their optical properties are similar to those of dielectrics. In the IR region, semiconductors are relatively transparent; some of them (for example, Ge, ZnSe) are used for the manufacture of optical infrared elements.

METHODS

The semiconductor surface is an inevitable macroscopic violation of the periodicity of the crystal lattice. Electronic processes on and near the surface are influenced not only by the trapping and recombination centers, but also by the state of the space charge region, which is caused by the existence of surface local centers. Such centers can be associated both directly with the cutoff of periodicity and with adsorbed atoms and molecules.

RESULTS AND DISCUSSIONS

When analyzing the thermal effect of radiation on semiconductors, the following mechanisms of absorption of electromagnetic radiation are distinguished [1, p.42]:

1. Intrinsic (interband) light absorption. If the energy of the quantum is greater than the band gap (> E3), then due to the internal photoelectric effect, electrons from the valence band pass into the conduction band. Their lifetime until the moment of electron-hole recombination with the release of heat in the lattice is approximately 10-7 - 10-8 s. The semiconductor begins to approach metals, and its reflectivity increases. At the same time, when radiation is absorbed by free carriers, the so-called. "Heating" (acceleration of motion) of an initially small number of electrons in the conduction band, which leads to an increase in the electron concentration as a result of thermal ionization of the valence band, i.e. a self-accelerating process of heating the substance can take place. The absorption coefficient is 105 - 106 cm-1.

2. Intraband absorption (absorption by free carriers by electrons and holes). In essence, it is similar to absorption by free electrons in metals, but differs in the concentration of free carriers, which is small in the equilibrium state (1014 - 1017 cm-3). The coefficient of this absorption is 1014 - 1017 cm-1.

3. Impurity absorption. It involves carriers with energy states located in the forbidden zone (<E3). The absorption coefficient is 10 cm-1

4. Lattice (residual) absorption. It occurs when the radiation interacts directly with the ions of the semiconductor. In this case, the electronic subsystem remains unused. In this case, the photon interacts with the phonon, which has a quantum character with rather broad lines. The absorption coefficient at resonance is cm-1

At the same depths, the energy absorbed by free carriers is converted into heat. The transfer of energy from the surface layers of a semiconductor along its volume is carried out by thermal conductivity [2, p.45]. At the initial stage of the process, when the concentration of free electrons in the semiconductor is insignificant, lattice thermal conductivity prevails. As the concentration increases, more and more of the energy is transferred by conduction electrons, and they make a significant contribution to the total thermal conductivity. Energy transfer in semiconductors can also be carried out using recombination radiation [2, p.54].

CONCLUSION

Based on the foregoing, it can be concluded that by the nature of their susceptibility to laser radiation, semiconductors occupy an intermediate position between metals and transparent materials. As a result of absorption of laser radiation by semiconductors, electron-hole pairs are formed, which transfer radiation energy to the crystal lattice during recombination. Therefore, with an increase in the power of laser radiation, damage to the material will occur as a result of heating. This damage process is typical for lightly doped silicon. However, if the semiconductor is heavily doped, the damage is similar to damage in metals.

The surface finish of the semiconductor also has a large influence on the damage threshold in the material. Etching increases the threshold of relatively coarsely ground crystals by more than 3 times, and for those made by chipping or chemical grinding - by 10-15%. Scratches have little effect, although damage in the scratched area is more noticeable.

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