

## Linear Electrical Conductivity of a Bipolar Semiconductor: Recombination and Heating

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The nonequilibrium electrons and holes non-uniformly distributed arise in a bipolar semiconductor near its contacts with a metal when an electrical current flows through it. It causes non-uniform recombination, which creates nonuniform dissipation of heat [1] due to which the non-uniformly distributed temperature gradient arise [2]. It generates the thermal electrical currents, which together with the diffusion currents change the electrical conductivity of a semiconductor. It is shown that this electrical conductivity depends particularly on the thermal conductivity. It is shown that the electrical conductivity of a bipolar semiconductor of any lengths is equal to the sum of the electrical conductivities of electrons and holes only in the case of infinitely strong surface recombination on the contacts of the semiconductor with the metal. The partial cases are considered: the semiconductor with the large value of the thermal conductivity; the monopolar electron semiconductor; the monopolar hole semiconductor; the infinitely weak and strong values of the surface recombination rate; the different lengths of a semiconductor with respect to the generalized diffusion length, which depends on the thermal conductivity and the characteristic length, which characterizes the surface recombination rate. The concrete expressions of the electrical conductivity are obtained in all partial cases. The criterion of utilization of isothermal approximation (the temperature has its equilibrium value) for the calculation of a resistance of a semiconductor, which consists in that the thermal conductivity of a semiconductor must be sufficiently large, is established.

### References

- [1]. Yuri G. Gurevich, Igor Lashkevych, *Int. J. Thermophys.*, 34, 341 (2013).
- [2]. Yuri G. Gurevich, Igor Lashkevych, *Int. J. Thermophys.*, 35, 375 (2014).