Conductive and Optical Properties of Different Metals and Semiconductors. Role of Magnetic Field.

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Abstract:

The Drude model for the conductivity of metals and semiconductors has been studied. The electrons are assumed to be free-moving particles which do not interact with any field between two collisions. The relaxation time for different metals and semiconductors is calculated by applying the Drude model. The results of the calculations show that better conductors are characterized by lower resistivity and higher relaxation time. The influence of magnetic field on the conductive properties of metals and semiconductors is analyzed. It is shown that the external magnetic field causes the non-zero off-diagonal elements of the tensor of conductivity to appear. These off-diagonal elements are determined by the Hall coefficient which has been calculated for different metals and semiconductors. The off-diagonal coefficients of the conductivity tensor have been compared for the Ordinary Hall Effect (OHE) and the Quantum Hall Effect (QHE) observed in two-dimensional electron gas (2DEG). The applications of QHE for the high-precision measurements of Planck's constant are analyzed and discussed. The influence of the band structure on the conductive and optical properties of metals, semiconductors, and dielectrics is studied and described. Based on the measurement of the light pumping effect on the conductivity of a semiconductor, the energy gap is calculated. The applications of semiconductors in solar cells are discussed.