Magnetoresistance in semiconductor structures with hopping conductivity: effects of random potential and generalization for the case of acceptor states

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Abstract

We reconsider the theory of magnetoresistance in hopping semiconductors. First, we have shown that the random potential of the background impurities affects significantly preexponential factor of the tunneling amplitude which becomes to be a short-range one in contrast to the long-range one for purely Coulomb hopping centers. This factor to some extent suppresses the negative interference magnetoresistance and can lead to its decrease with temperature decrease which is in agreement with earlier experimental observations. We have also extended the theoretical models of positive spin magnetoresistance, in particular, related to a presence of doubly occupied states (corresponding to the upper Hubbard band) to the case of acceptor states in 2D structures. We have shown that this mechanism can dominate over classical wave-shrinkage magnetoresistance at low temperatures. Our results are in semi-quantitative agreement with experimental data.

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