Mobility Edge Trajectory in Classical Lifshitz Problem

Y. V. Skrypnyk and V. M. Loktev

Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine

yuriy.v.skrypnyk@gmail.com, VLoktev@nas.gov.ua

Structure of the electronic spectrum in a vicinity of the host band edge is studied for a disordered three-dimensional system. Short-range impurities are treated within the conventional formalism of a substitutional binary alloy with a diagonal disorder, which is often referred to as the Lifshitz model. The mobility edge position at a given concentration of impurities is determined by combining the Ioffe-Regel criterion and the Ducastelle criterion with the analysis of the renormalized expansion of the self-energy of electrons into a cluster series. The mobility edge trajectory, which develops with increasing the impurity concentration c, is obtained analytically. Since the threshold value of the localization parameter in the Ioffe-Regel criterion is subject to debate, the evolution of mobility edge trajectory with varying this threshold value is examined for the case, when the disordered system undergoes the band structure transformation. It is demonstrated that the critical impurity concentration c_{cr}, which triggers the band structure transformation, changes slightly with varying this parameter, while the corresponding mobility edge position at the critical concentration remains stable. In contrast to the prevailing opinion that the mobility edge behaves proportionally to $c^{2/3}$ for $c > c_{cr}$, we show that there is a rather wide concentration window adjacent to c_{cr}, in which the mobility edge shifts proportionally to $c^{1/3}$.

1. Skrypnyk Y. V., Loktev V. M., On the possibility of estimating the position of the mobility edge for charge carriers using single-particle averages, Low Temperature Physics, 2018, **44**, 718-725.
2. Skrypnyk Y. V., Interdependency between localization parameter and criterion of the coherent-potential-approximation applicability, Phys. Rev. B, 2004, **70**, 212201.