LOCALIZATION EFFECTS IN RADIATIONALLY DISORDERED HIGH-TEMPERATURE SUPERCONDUCTORS: THEORETICAL INTERPRETATION

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Theoretical interpretation of recent experiments on radiationally disordered high-temperature superconductors is presented, based on the concepts of mutual interplay of Anderson localization and superconductivity.

Microscopic derivation of Ginzburg-Landau coefficients for the quasi-two-dimensional system in the vicinity of localization transition is given in the framework of self-consistent theory of localization. The "minimal metallic conductivity" for the quasi-two-dimensional case is enhanced due to a small overlap of electronic states on the nearest neigbour conducting planes. This leads to much more strong influence of localization effects than in ordinary (three-dimensional) superconductors. From this point of view even the initial samples of high-temperature superconductors are already very close to Anderson transition.

Anomalies of H_{c2} are also analyzed, explaining the upward curvature of $H_{c2}(T)$ and apparent independence of dH_{c2}/dT $(T=T_c)$ on the degree of disorder as due to localization effects.

We discuss the possible reasons of fast T_c degradation due to the enhanced Coulomb effects caused by the disorder induced decrease of localization length. The appearance and growth of localized magnetic moments is also discussed. The disorder dependence of localization length calculated from the experimental data on conductivity correlates reasonably with the theoretical criterion for suppression of superconductivity in the system with localized electronic states.