Phase diagrams and thermodynamic properties of the Penson–Kolb–Hubbard model: s-wave pairing vs η-paring.

S. Robaszkiewicz and W. R. Czart
Institute of Physics,
Adam Mickiewicz University
Umultowska 85, 61-614 Poznań, Poland

9.7 cm

Thermodynamic and electromagnetic characteristics of the Hubbard model with pair–hopping interaction J, i.e. the Penson–Kolb–Hubbard model, are studied for d – dimensional hypercubic lattices ($d = 2$ (SQ) and $d = 3$ (SC)). In the analysis we focus on the properties of the superconducting states with Cooper-pair center-of-mass momentum $q = 0$ (s-phase) and $q = \vec{Q}$ (η-phase). The evolutions of the critical temperatures, the gap to T_c ratios and the phase diagrams with interaction parameters and band filling are determined. The s-phase is found to exhibit a smooth crossover from the BCS-like limit to the tightly bound pairs regime with increasing pairing strength. On the contrary, the transition into the η-phase correspond to an abrupt change in the ground state structure. For $J \neq 0$ both these phases can survive also for repulsive on-site density interaction U ($U < U_c$). For the s-phase and $d = 2$ SQ lattice the effects of phase fluctuations on the transition temperature are examined within the Kosterlitz– Thouless (KT) scenario. The KT critical temperatures T_c and the London penetration depth λ are calculated and the T_c vs $\lambda^{-2}(0)$ plots are derived. Except for weak coupling limit these plots have a shape similar to the experimental Uemura's plots obtained for various classes of short–coherence length superconductors.

13.4 cm

Subject category :

1. Correlated Electrons and High Temperature Superconductors

Presentation mode :
poster

Corresponding author :
W. R. Czart

Address for correspondence :
Institute of Physics,
Adam Mickiewicz University
Umultowska 85, 61-614 Poznań, Poland

Email address :
czart@amu.edu.pl