THE PHASE DIAGRAM AND THE STRUCTURE OF CHARGE-DENSITY-WAVE STATE IN HIGH MAGNETIC FIELD

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Introduction

The charge-density wave (CDW) is usually damped by high magnetic field. However, this damping is not complete and at high magnetic field the CDW may survive having though a modified structure. In particular, the wave vector of this high-field CDW shifts from its low-field optimal value as was predicted in [1] and observed in many experiments on organic metals (see, e.g., [2-6]). Theoretically this problem has been studied only through the susceptibility calculation [1] which does not describe the CDW properties below transition temperature since is applicable only in the normal phase. Another (soliton) approach [7] uses too many approximations (zero temperature, perfect nesting, proximity to half-filling of the conducting band).

Results and Discussion

A mean-field theory of the CDW state in magnetic field is developed using the Landau functional analysis, which takes into account imperfect nesting and the shift of the CDW wave vector. A detailed study of the high-field CDW properties below the transition temperature is performed. The CDW state with shifted wave vector in high magnetic field (CDW_x phase) has at least double harmonic modulation on the most part of the phase diagram. The transition from the low field CDW_0 to high-field CDW_x state below the critical temperature is accompanied by a jump of the CDW order parameter and of the wave vector rather than by their continuous increase assumed in [1]. This implies a first order transition between these CDW states and explains the strong hysteresis accompanying this transition in many experiments [2-6]. The phase diagram of the CDW state in magnetic field is calculated. The changes of the phase diagram in the case of imperfect nesting are examined. The properties and the density of states in the high-field CDW phase are described. The spin-asymmetric properties of the single-harmonic CDW phase are proposed, and its region on the total B-T phase diagram is analyzed. In the perfect nesting case the single harmonic CDW_x exists only in a very narrow region near the tricritical point, however, its region may be wider for more complicated electron dispersion. Our study links the results of susceptibility calculations [1] and the results of the soliton approach [7].

Conclusions

The phase diagram and the properties of high-field CDW state are described. Some features on the phase diagram observed in organic metals are explained. New experiments to verify the predictions are suggested.

Acknowledgements

The work was supported (PG) by the NHMFL through the NSF Cooperative agreement No. DMR-0084173 and the State of Florida, and by INTAS No 01-0791 and RFBR.

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