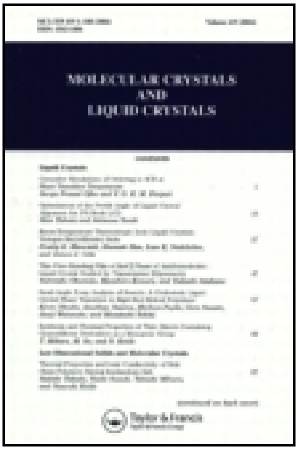

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ESR Study of (TMTTF)2BF4 and TTF-TCNQ under Hydrostatic Pressure

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ESR STUDY OF $(TMTTF)_2BF_4$ AND TTF-TCNQ UNDER HYDROSTATIC PRESSURE

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Abstract - We have measured the susceptibility, g-factor and linewidth of $(TMTTF)_2BF_4$ and TTF-TCNQ single crystals in the 80-300K temperature range up to 5 kbars of hydrostatic pressure in X-band. The decrease of the susceptibility and the increase in the linewidth on pressure is less expressed in $(TMTTF)_2BF_4$ than in TTF-TCNQ. The g-factor does not depend on pressure in both cases.

INTRODUCTION

In the study of the magnetic properties of organic conductors one of the most interesting problem is the enhanced and temperature dependent susceptibility (χ) in the high temperature metallic phase. Among the large number of organic conductors which exhibit these properties, the most studied compound is TTF-TCNQ. The magnitude of χ at romm temperature is about 3 times larger than the value calculated with bandwidth deduced from optical or thermopower measurements[1]. Furthermore from room temperature (R.T.) to the phase transition at 54 K it decreases a bit more than factor 2, what is strange for the Pauli paramagnetism. In clarifying the source of the enhancement and temperature dependence of χ one of the complicating circumstances is the complexity of the system: partially charge transfer, two kinds of conducting chains etc. From this point of view $(TMTTF)_2BF_4$ is more promising candidate, where is only one type of conducting chains and the charge transfer is total to the BF_4 acceptors[2]. The enhancement factor is ~ 4 and the susceptibility before the phase transition temperature at 41K makes 60% of χ at R.T.[2]

Pressure is know to be an important parameter in the study of quasionedimensional metals. In the pioneering experiment of Berthier et al.[3] the susceptibility of TTF-TCNQ has shown a high sensitivity on pressure. However in low field measurements at 40 MHz, the signal width was comparable to the applied static field, the powdered sample couldn't give information on the g factor, and it wasn't clear what is the contribution of the increased conductivity through the skin-effect to the lowering of the susceptibility under pressure.

The purpose of this paper is to give comparative date on the pressure dependence of the susceptibility, TTF-TCNQ and $(TMTTF)_2BF_4$ single crystals.

The main features of the g-factors and linewidths are given in the abstract, but because of space limitations the detailed discussion will be given elsewhere.

EXPERIMENTAL & RESULTS

We have performed ESR measurements in X-band on single crystals in orientation which minimizes or excludes the skin effect. The temperature and pressure ranges were 80-320K and 0-5 kbars. Copper sulfate single crystal was used as reference for the signal intensity. The detailed description of the experimental setup is given in reference 4.

Figure 1 shows the pressure dependence of χ at R.T. for TTF-TCNQ and $(TMTSF)_2BF_4$. For TTF-TCNQ χ decreases by 8±1%/kbar, while for $(TMTTF)_2BF_4$ is decreased by 3±5%/kbar. The temperature dependences are given on figure 2. For TTF-TCNQ the temperature dependence of χ at 5 kbars is weaker than at normal pressure. For

$(TMTTF)_2BF_4$ χ goes roughly together for both pressures but the scatter in the experimental points is bigger.

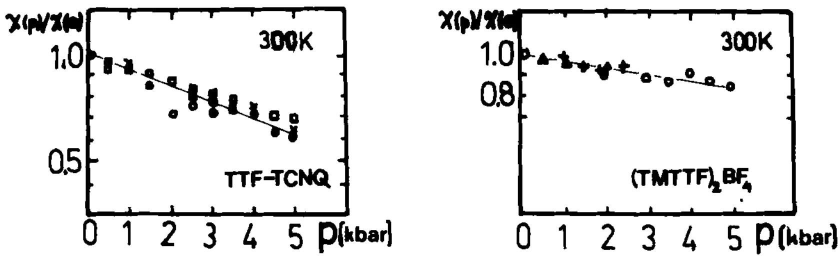

FIGURE 1. Pressure dependence of the normalized susceitibility for TTF-TCNQ and $(TMTTF)_2BF_4$ at 300K for several samples.

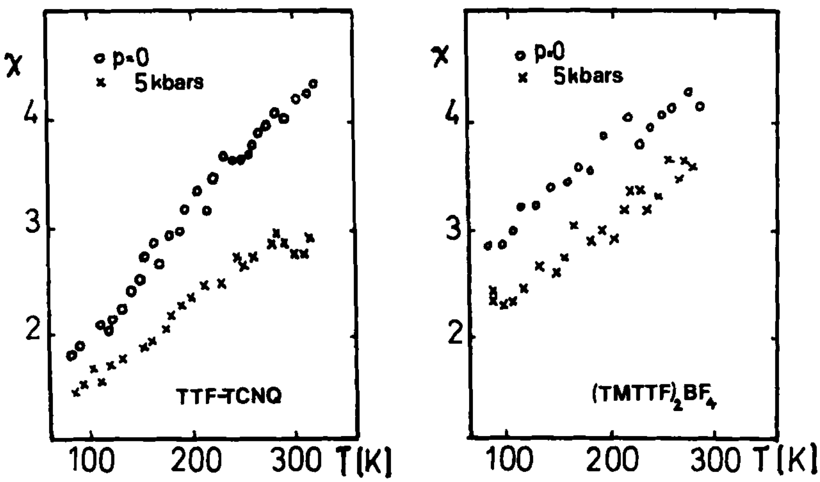

FIGURE 2. Temperature dependence of the susceptibility (in arbitrary units) at normal and 5 kbars pressures for TTF-TCNQ and $(TMTTF)_2BF_4$.

DISCUSSION

In TTF-TCNQ, as was pointed out by J.Cooper[5], the changes in bandwidth due to the lattice contraction or charge transfer couldn't account for the observed decrease of the susceptibility. Jerome et al[6] has evoked Coulomb interactions and the strong length dependence of the interchain screening of Coulomb correlations to explain the enhancement of χ, its temperature and pressure dependence in TTF-TCNQ and TMTTF-TCNQ. For the precise comparison of the susceptibility data of TTF-TCNQ and $(TMTTF)_2BF_4$ in pressure one should need the compressibility data of $(TMTTF)_2BF_4$. As far as we know, these data are not available. Supposing similar compressibility, the screening of Coulomb interactions should be smaller in $(TMTTF)_2BF_4$ since instead of the well polarizable TCNQ chain with extended, metallic electrons, we have the isolated, poorly polarizable BF_4 molecules. This fact should play an important role in the much smaller decrease of χ in $(TMTTF)_2BF_4$ on pressure.

It is worth to mention that an alternate model[7] based on the band narrowing effect due to the short mean free path of the charge carriers should account qualitatively for the strong pressure dependence of χ.

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