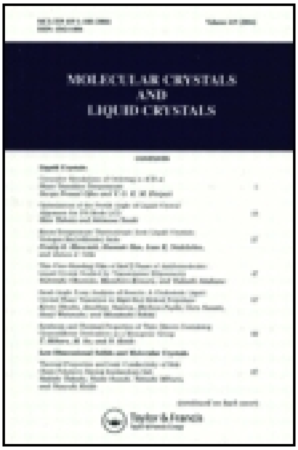

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Magnetic and Spectroscopic Properties of $(TMTTF)_2(SbF)_{1-x}(AsF_5)_x$

R. Laversanne [a] , J. Amiell [a] , C. Coulon [a] , C. Garrigou-lagrange [a] & P. Delhaes [a]

[a] Centre de Recherche Paul Pascal, Domaine Universitaire, 33405, TALENCE cedex, France

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MAGNETIC AND SPECTROSCOPIC PROPERTIES OF $(TMTTF)_2(SbF_6)_{1-x}(AsF_6)_x$

R. LAVERSANNE, J. AMIELL, C. COULON, C. GARRIGOU-LAGRANGE and P. DELHAES
Centre de Recherche Paul Pascal, Domaine Universitaire, 33405 TALENCE cedex FRANCE

ABSTRACT $(TMTTF)_2SbF_6$ shows an anomaly on the temperature dependence of its electrical conductivity at 154K and at low temperature an antiferromagnetic ground state. On the other hand $(TMTTF)_2AsF_6$ ground state is non-magnetic. We present the spectroscopic and magnetic studies of these two salts and of their alloys $(TMTTF)_2(SbF_6)_{1-x}(AsF_6)_x$.

The knowledge of the low temperature ground state is an important asset in the study of an organic conductor. The nature of this ground state is often related with the high temperature behaviour of the compound as for example in $(TMTTF)_2SCN$[1]. More generally the competition between the ground states is at least partially driven by the interaction between anions and organic stacks as proposed by Bruinsma et al[2]

In order to study the influence of the anion we have performed spectroscopic (I.R.) and magnetic measurements of the two pristine salts $(TMTTF)_2SbF_6$ and $(TMTTF)_2AsF_6$ and of their alloys.

The D.C. electrical conductivity of $(TMTTF)_2SbF_6$ shows an anomaly at 154K[3]. A possible explanation of this behaviour is an ordering of the centrosymmetrical SbF_6 anion. A recent specific heat study[4] of this compound fails to detect any anomaly of C_p in the range 10K-300K. This result together with recent X-ray measurements which show no evidence for either $4k_F$ or $2k_F$ scattering[3] [5] probably indicate that the electronic localization is not related with an order-disorder phase transition.

The ordering of non-centrosymmetrical anions is clearly evidenced by infrared spectroscopy. For example the intensity of the ν_4 vibronic line increases at the order-disorder transition in ReO_4 or BF_4 salts of both TMTTF and TMTSF[6] and the ν_4 frequency shifts at the temperature transition in the SCN and ReO_4 TMTSF salts[7]. In both AsF_6 and SbF_6 salts of TMTTF no frequency shift is detected on the ν_4 vibronic line between 15K and 300K.

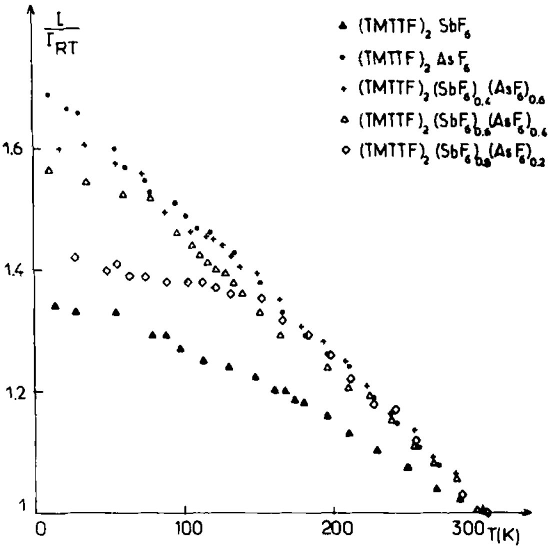

FIGURE 1 Temperature dependence of the normalized intensity of the ν_4 vibronic line

The intensity of this line increases monotonously in the AsF_6 and SbF_6 salts but however with a saturation at low temperature for this last salt (figure 1). By alloying, the behaviour of the I.R. spectrum evolves regularly between that of the two undoped samples.

These results are in agreement with the hypothesis that in $(TMTTF)_2SbF_6$ the electronic localization occurs without any condensation of a new long range order.

The E.P.R. results and static magnetic susceptibilities are given figure 2 and 3 for the pristine salts. The temperature dependence of the E.P.R. signal of $(TMTTF)_2SbF_6$ shows two characteristic features. First a bump of the linewidth around 154K reminiscent of the electrical anomaly is observed. Then a divergence of the linewidth is found at low temperature together with a slight decrease of the g-factor. At the same time the static magnetic susceptibility remains finite as the temperature approaches zero. This behaviour already found for the SCN salt[1] usually indicates the condensation of an antiferromagnetic ground state. The occurence of such a ground state below $T_c \simeq 8K$ has been recently confirmed through antiferromagnetic resonance[8] and magnetic anisotropy measurements[9].

On the other hand the AsF_6 salt shows a broadening of the E.P.R. linewidth, but the static magnetic susceptibility is activated below $T_c \simeq 12K$. These results are most likely related to the condensation of a non-magnetic ground state induced by a Spin-Peierls transition as confirmed by magnetic anisotropy measurements[9].

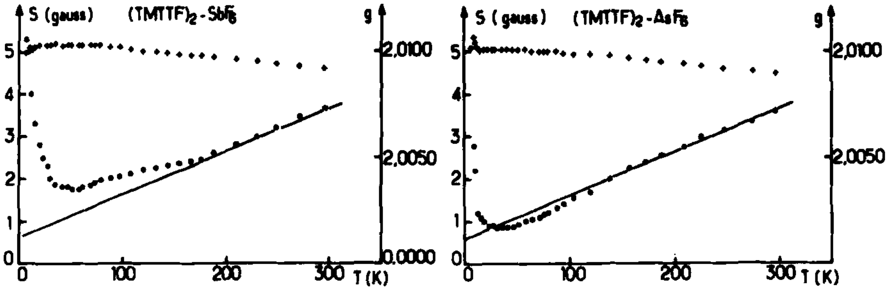

FIGURE 2 E.P.R. linewidth (....) and g-factor (++++) T dependences. The static magnetic field was parallel to the short axis of the TMTTF molecule.

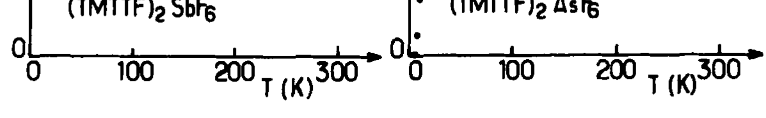

FIGURE 3 Temperature dependence of the static magnetic susceptibility

The $(TMTTF)_2(SbF_6)_{1-x}(AsF_6)_x$ alloys behave in the same way as the undoped salts when $x < 0.2$ (close to SbF_6) and $x > 0.8$ (close to AsF_6). Around $x \simeq 0.5$ neither an A.F. nor a N.M.

ground state is observed above 5K suggesting that the disorder induced by the anions dominates the low temperature properties of these materials. However a continuous behaviour versus x is found as far as the high temperature anomaly is concerned. This anomaly is reflected in both the conductivity, E.P.R. linewidth and I.R. properties. That means that the SbF_6 salt is not singular among the TMTTF series. On the contrary a similar anomaly is observed for several compounds even prepared with anions of different symmetries[10]. Among the salts with octahedral anions the SbF_6 compound is only the material for which the electronic localization occurs at the highest temperature.

In this picture it may be suggested that there is a correlation between the nature of the low temperature ground state and the high temperature electronic localization, even if no real phase transition is associated with this effect. A more extensive discussion together with new experimental data concerning these samples will be presented in forthcoming publication.

REFERENCES

1. C. COULON, A. MAAROUFI, J. AMIELL, E. DUPART, S. FLANDROIS, P. DELHAES, R. MORET, J.P. POUGET and J.P. MORAND, Phys. Rev. B 26,6322 (1982)
2. V.J. EMERY, R. BRUINSMA, S. BARISIC, Phys. Rev. Lett. 48,1035 (1982)
3. R. LAVERSANNE, C. COULON, B. GALLOIS, J.P. POUGET and R. MORET, J. Phys. Lett. 45,L393 (1984)
4. E. BONJOUR Private communication
5. J.P. POUGET, R. COMES, K. BECHGAARD, J.M. FABRE and L. GIRAL, Physica 108B,1187 (1981)
6. R. BOZIO, C. PECILE, J.C. SCOTT and E.M. ENGLER, These Proceedings
7. C. GARRIGOU-LAGRANGE, A. GRAJA, C. COULON and P. DELHAES J. Phys. C to appear
8. C. COULON, J.C. SCOTT, R. LAVERSANNE, These Proceedings
9. A. MAAROUFI, S. FLANDROIS, G. FILLION, J.P. MORAND, These Proceedings
10. C. COULON, S.S.P. PARKIN, R. LAVERSANNE, These Proceedings