Magnetocapacitive coupling in spin density wave systems

Damir Starešinić[1], Damir Dominko[1], Peter Lunkenheimer[2], Georgy Remenyi[3] and Hiroshi M. Yamamoto[4]
[1]*Institute of Physics, Zagreb, Croatia*
[2]*Institute of Physics, University of Augsburg, Augsburg, Germany*
[3]*Institute Neel, CNRS, Grenoble, France*
[4]*Condensed Molecular Materials Laboratory, RIKEN, Saitama, Japan.*

Email:damirs @ifs.hr

The quasi one-dimensional systems of $(TMTSF)_2X$ family exhibit a wealth of fascinating phenomena covering several important topics of solid state physics. They typically undergo a transition into the spin density wave (SDW) state which can be regarded as the incommensurate antiferromagnetic state [1]. On the other hand, at temperatures sufficiently below the SDW transition temperature they exhibit a ferroelectric-like increase of the dielectric constant accompanied by the slowing down of the low frequency relaxation process which undergoes eventually a transition into a glassy state [2]. Such phenomena are typical for so-called relaxor ferroelectrics. The multiferroic nature of the SDW ground state suggests that the magnetic and dielectric properties are mutually dependent [3].
Our measurements of the low frequency dielectric response of two SDW systems, $(TMTSF)_2AsF_6$ and $(TMTSF)_2PF_6$, in magnetic field demonstrate strong coupling of the magnetic and charge degrees of freedom. Increasing the field up to 8 T in the direction of the SDW hard axis increases the dielectric constant and the relaxation time up to one order of magnitude, particularly in the vicinity of the glass transition temperature near 2 K.
This magnetocapacitive effect is more pronounced that the well-known magnetoresistive effect [4] observed in the same samples. Therefore it cannot be explained by the change of the free carrier screening only and the direct influence of the magnetic field on the SDW state has to be considered, either through the softening of SDW or through the decrease of the pinning.

*This work was supported by Croatian MSES project 035-0352827-2842 and by DFG via SFB 484

[1] W. M. Walsh *et al.*, Phys. Rev. Lett, 45 (1980) 829; J. C. Scott et al., Phys. Rev. Lett, 45 (1980) 2125
[2] F. Nad', P. Monceau, K. Bechgaard, Solid State Commun. 95 (1995) 655
[3] J. J. Betouras, G. Giovannetti, J. Van den Brink, Phys. Rev. Lett. 98 (2007) 257602
[4]P. M. Chaikin, P. Haen, E. M. Enler, R. L. Greene, Phys. Rev. B 24 (1981) 7155