

MAR08-2007-004160

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Polarons and Coulomb interactions in organic transistors

SIMONE FRATINI, Institut Neel - CNRS

In organic Field Effect Transistors (FETs), charge carriers accumulate in a two-dimensional layer at the interface between an organic crystal and a gate dielectric. The possibility of tuning several microscopic parameters such as the carrier density, the electron-electron and electron-phonon interactions makes these devices an interesting playground for fundamental physics. Recent experiments have demonstrated that depending on the gate insulator used, the electric mobility in organic FETs can be tuned from metallic-like to insulating-like. This phenomenon can be explained in terms of the formation of small polarons, due to the remote interaction of the charge carriers with the phonons of the gate material [1]. In the devices with the highest polarizabilities, experiments performed at large gate voltages (corresponding to ~ 0.1 carriers/molecule) have revealed a further reduction of the mobility, suggesting the onset of electron-electron interactions [2]. The physics of this novel regime involving both strong electron-phonon and long-range electron-electron interactions will be discussed. If time allows, I shall briefly present how the above picture is modified when the narrow-band organic crystal is replaced by graphene—a two-dimensional sheet of carbon atoms. Although the effect is less striking in that case, the remote scattering with the substrate phonons still constitutes an important limiting factor of the mobility at room temperature, that should be addressed for the design of future graphene devices [3].

References:

- [1] I. N. Hulea, S. Fratini, H. Xie, C. L. Mulder, N. N. Iosad, G. Rastelli, S. Ciuchi and A. F. Morpurgo, *Nature Materials* 5, 982-986 (2006)
- [2] S. Fratini, H. Xie, I. N. Hulea, S. Ciuchi, and A. F. Morpurgo, arXiv:0710.2845 preprint (2007)
- [3] S. Fratini, F. Guinea, arXiv:0711.1303 preprint (2007)