Hopping conduction at high field in disordered molecular system

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The hopping conduction in disordered organic molecular medium has been brought into focus particularly in relation to new electronic devices based on thin organic films. These systems operate under very high electric fields of the order of 1 MV/cm, with particle mobility being strongly dependent on the electric field. The dependence, rather universally found in the experiment, is of the form $\ln(\mu(F)) \propto \sqrt{F}$. Through numerical simulations this dependence has been previously related to energy-level correlations within disordered medium, while exact proof has been presented only for very specific 1D model with correlated disorder. We examined the issue for several types of correlated disorder in 3D systems. Beyond calculating the mobility $\mu(F)$, we examined the properties of the ensemble of particles hopping in the high electric field. It turns out that the site-occupancy probability may be always expressed through an effective temperature and the variable uncorrelated to the site energy but related to the buildup of the charge fluctuation correlations in the direction of the field, and their absence in the transverse direction. This is further related to current filaments buildup in thin organic films, probably driving the ageing of present organics based electronic devices.

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