Field-Dependent Mobilities by Field-Inhibited Partial Polaron Formation

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Abstract

The injection of a charge into an insulator should be accompanied by considerable molecular reorganization and self-trapping. Nonetheless, recently, the effects of polaron formation have been thought to be of secondary importance as compared to the degree to which correlated energetic disorder gives rise to the strongly field-dependent (Poole-Frenkel) mobilities in disordered organic solids. On the other hand, complete molecular relaxation around an isolated charge may take considerable time. In fact, if the relaxation time is longer than the average dwell time, an injected charge will tend to hop from molecule to molecule as a "partial polaron". Under these circumstances, the mobility is extremely sensitive to small changes, as these may greatly increase or decrease the degree of polaron formation. In this talk we consider the change in mobility arising from an electric field on the order of 1 to 10KV/cm. We show that an apparently insignificant reduction of the "bare" dwell time by the applied field leads to a reduction in polaron formation, which in turn gives rise to an enormous (exponential) increase in mobility.

Biography

David Dunlap is an associate professor of physics at the University of New Mexico. His work has focused on transport phenomena in the solid state such as Anderson localization, Bloch oscillations, polaron formation, and hoping transport with spatial and energetic disorder in molecular solids.