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Unified Theory of Charge Transport in Wide-Band and Narrow-Band Semiconductors FRANK ORTMANN, FRIEDHELM BECHSTEDT, KARSTEN HANNEWALD, ETSF and IFTO, Friedrich-Schiller-University Jena, Germany — The charge carrier mobility is often calculated within one of the two limiting cases: wide bands or narrow bands. In the case of wide-band systems, usually pure band transport is assumed along with a calculated relaxation time. In contrast, for narrow-band materials, hopping is usually considered prevalent and the interaction with lattice vibrations is described within the polaron concept. In this talk, we will present a unified approach to the description of charge transport based upon the Kubo formalism applied to a Holstein Hamiltonian. As a result, we obtain an analytical formula for the temperature dependence and anisotropy of the mobility describing a seamless transition from band transport at low temperatures to hopping transport at high temperatures. The results are illustrated for naphthalene crystals and a comparison to previous approaches [1,2] is made.

[1] V.M. Kenkre, Phys. Lett. A 305, 443 (2002)

[2] K. Hannewald and P.A. Bobbert, Phys. Rev. B 69, 075212 (2004)

Frank Ortmann
ETSF and IFTO, Friedrich-Schiller-University Jena, Germany

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