Thermal and Field Dependence of the Conductivity of Terbium(III)-Phthalocyaninato Double-Decker Complex ($TbPc_2$) Terbium Bisphthalocyanine Thin Films

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Terbium bisphthalocyanine thin films were found to exhibit exceptional electrical stability, enabling the present precise study of the Ohmic and space charge limited currents over a range of temperature between 203 K and 423 K, and electric fields up to 5 MV m^{-1}. While both were found to be thermally activated, the Arrhenius plot of the Ohmic currents revealed a slight curvature consistent with the pre-factor having a linear temperature dependence while the activation energy is a temperature-independent (and field-independent) constant of 0.158 eV. The energetics do not conform to the expected behavior for hopping transport[1], leading to the conclusion that the conductivity in terbium bisphthalocyanine is regulated by two factors, a thermally activated charge dissociation[2] (i.e. intrinsic conduction with a transport gap of 0.316 eV) and a charge carrier mobility which varies linearly with temperature.

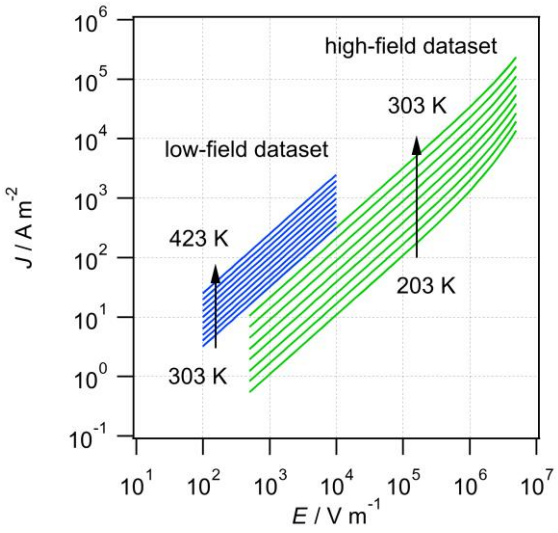

Fig 1. Current density vs. applied field data, obtained for a 5 nm thick, annealed $TbPc_2$ film sample. All current readings are stable within 2% with respect to multiple repeat measurements made over a 48 h interval. Conductance is Ohmic below 10^4 V m^{-1}.

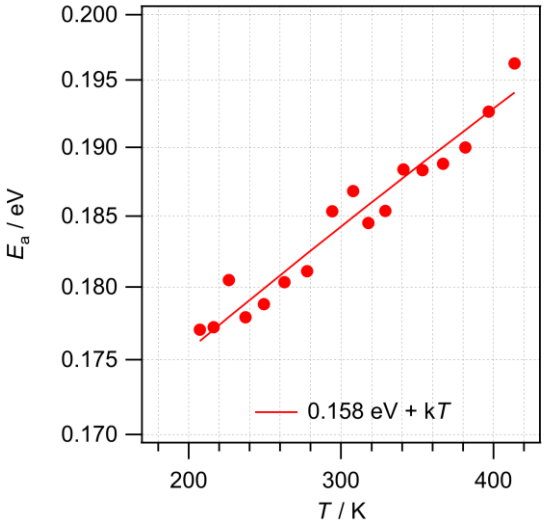

Fig. 2 The activation energy as a function of temperature, calculated as $-k\,\Delta(\ln\sigma)/\Delta(1/T)$ from conductivities derived from the Ohmic conductance data in Fig. 1. The data is compared to a least squares fit having a slope equal to the Boltzmann constant, *k*.

1. D. Monroe, *Phys. Rev. Lett.* **54**, 146 (1985).

2. M. Bouvet and J. Simon, *Chem. Phys. Lett.* **172**, 299 (1990).