



Transient charging of copper phthalocyanine: model and experiment

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Abstract

Thin films of copper phthalocyanine (CuPc) were deposited on indium tin oxide (ITO) substrates in ultra-high vacuum. Without breaking the vacuum, Ag dots were evaporated through a shadow mask. The present contribution is aimed at comparing experimental and simulated data on feedback-charge capacitance/voltage (C/V) and isothermal charge deep-level transient spectroscopy (Q-DLTS) of Ag/CuPc/ITO devices kept at ambient temperature. Two types of charge relaxation of different origins in response to a bias step (pulse) ΔU were resolved: (a) dielectric relaxation within the bulk of the CuPc semi-insulating layer; (b) emission from traps of charges injected and captured at the traps during the pulse. The dielectric relaxation is characterized by a well-defined time constant $\tau_D \approx 10^{-4}$ s and is observable for both polarities of ΔU . The onset bias for observing the emission from traps corresponds roughly to one of the forward current. A positive ΔU is to be applied to ITO (hole injecting anode) in order to fill at least a fraction of the traps. Realizing that the traps are spatially distributed, the model previously applied to C/V of a Si:H based devices has been updated to obtain at least a qualitative picture about the spatial distribution of the density of traps $N_T(x)$ in CuPc. $N_T(x)$ seems to rise when approaching the CuPc/ITO interface. These states are classified as acceptor-like ones, a situation analogous to that reported earlier for poly-(*p*-phenylene-vinylene). Protonation of the CuPc/ITO interface is discussed as the source of the acceptor-like states.

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