Applied Surface Science
Volumes 212-213 , 15 May 2003, Pages 542-546
11th International Conference on Solid Films and Surfaces

doi:10.1016/S0169-4332(03)00053-9 Cite or Link Using DOI

Peculiar features in the electrical characteristics of CuPc based diodes

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Available online 12 February 2003.

Abstract

We have investigated electrical properties of copper phthalocyanine (CuPc) thin films by means of current–voltage (*I–V*), capacitance–voltage (*C–V*) and charge deep-level transient spectroscopy (*Q*-DLTS) measurements. CuPc films were deposited on indium tin oxide (ITO) via organic molecular beam deposition (OMBD) at room temperature followed by Ag evaporation through a shadow mask, resulting in contacts of different sizes of dots. The measurements were carried out *in situ* at a pressure below 8×10^{-10} mbar. No noticeable changes of electrical characteristics have been found after storing the devices for a few days under these conditions. Diodes of 330 nm CuPc sandwiched between ITO and Ag show very low reverse currents with hysteresis-like characteristics for short delay times, which are the times between two consecutive voltage steps in an *I–V* measurement. Especially the bias at which current passes through zero is drastically affected by the sweep voltage direction. Almost identical curves in both directions can only be achieved using an extremely long delay time of 100 s. It was found that the offset voltages for delay times of 5 and 100 s are −0.85 and −0.1 V for up-sweep and 0.14 and 0 V for down-sweep voltage directions, respectively. This effect is likely due to the presence of deep traps which require a large time constant for charging and discharging in response to a change of the external voltage. The forward current, on the other hand, is virtually not affected, increasing initially over many orders of magnitude in a narrow voltage range and then increasing at a reduced slope. This behaviour is not stable when a high external voltage is applied. *Q*-DLTS measurements show presence of traps with time constants exceeding 50 ms at ambient temperature.

Author Keywords: CuPc; *I–V*; *C–V*; *Q*-DLTS

PACS classification codes: 76.61.Ph; 81.15.Ef
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