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Copper Phthalocyanine Nanostructures: A Potential Material for Field Emission Display

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Abstract : Organic semiconductors have gained potential interest in the last few decades for their significant contributions in the various fields such as solar cell, non-volatile memory devices, field effect transistors and light emitting diodes etc. The most important advantages of using organic materials are mechanically flexible, light weight and low temperature depositing techniques. Recently with the advancement of nanoscience and technology, one dimensional organic and inorganic nanostructures such as nanowires, nanorods, nanotubes have gained tremendous interests due to their very high aspect ratio and large surface area for electron transport etc. Among them, self-assembled organic nanostructures like Copper, Zinc Phthalocyanine have shown good transport property and thermal stability due to their π conjugated bonds and π-π stacking respectively. Field emission properties of inorganic and carbon based nanostructures are reported in literatures mostly. But there are few reports in case of cold cathode emission characteristics of organic semiconductor nanostructures. In this work, the authors report the field emission characteristics of chemically and physically synthesized Copper Phthalocyanine (CuPc) nanostructures such as nanowires, nanotubes and nanotips. The as prepared samples were characterized by X-Ray diffraction (XRD), Ultra Violet Visible Spectrometer (UV-Vis), Fourier Transform Infra-red Spectroscopy (FTIR), and Field Emission Scanning Electron Microscope (FESEM) and Transmission Electron Microscope (TEM). The field emission characteristics were measured in our home designed field emission set up. The registered turn-on field and local field enhancement factor are found to be less than 5 V/μm and greater than 1000 respectively. The field emission behaviour is also stable for 200 minute. The experimental results are further verified by theoretically using by a finite displacement method as implemented in ANSYS Maxwell simulation package. The obtained results strongly indicate CuPc nanostructures to be the potential candidate as an electron emitter for field emission based display device applications.

Keywords : organic semiconductor, phthalocyanine, nanowires, nanotubes, field emission
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