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# Fabrication and performance studies of $TiO_2$ and Porphyrin Heterojunction based organic photodetector

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Organic photodetector of $TiO_2$/Porphyrin has been fabricated and its performance has been tested in dark and under various illumination of light intensity from 20 to 100 $mWcm^{-2}$. Four samples of porphyrin films have been used in the device, namely 1, 3, 5 and 7 times spin coating. $TiO_2$ films were deposited onto ITO covered glass substrate by controlled hydrolysis technique assisted with spin coating technique. Then porphyrin film was deposited on $TiO_2$ using spin coating technique. The films of $TiO_2$/porphyrin has absorbance maximum at 660 nm, which is in the red region. An aluminium electrode was prepared on top of porphyrin films by electron beam evaporation technique. The device shows rectification behaviour in the dark and shows photosensitization effect under illumination of visible lights. The device with 3 times spin coating of porphyrin shows the highest $J_{sc}$ of 1.02 $\mu Acm^{-2}$ and $V_{oc}$ of 520 mV.

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## 1. Introduction

The growth of works toward organic electronic devices motivated by their flexibility, luminescence in the visible range, large covered area and ease of fabrication, has led to the successful realization of light-emitting diodes [1-2], transistors [3-4] and phototransistors [5]. Concerning light-detecting devices, research and industrial interests have focused on photovoltaic cells [6-7], with a very few attempts toward photodetectors [8-9].

The potential applications of porphyrins in the design of functional materials, sensors, catalysts, and sieves are well documented [10-11]. The rich photochemistry and redox chemistry is readily modulated by both the nature of the substituents on the macrocycle and of the metallo derivatives. Porphyrins are a ubiquitous class of naturally occurring molecules involved in a wide variety of important biological processes ranging from oxygen transport to photosynthesis and from catalysis to pigmentation changes. The common feature of all these molecules is the basic structure of the macrocycle, which consists of four pyrrolic subunits bridged by four (meso) carbon atoms. This macrocycle is an aromatic system, the size of which is perfect to bind almost all metal ions and, indeed, a number of metals (e.g. Mg, Fe, Zn, Cu, Ni, and Co) can be inserted in the center of the macrocycle to form metallo-porphyrins (Fig.1).

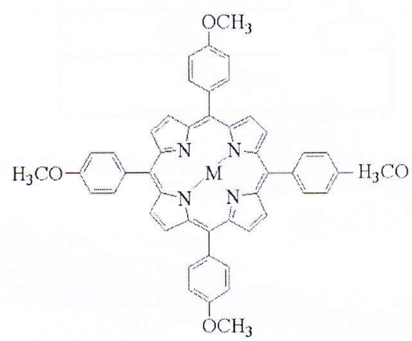


*Fig. 1. Molecular structure of metallo-porphyrins*

Metallo-porphyrins structure that has Mg metal ion has similarity with Chloropyll-A structure. It has been used as the organic semiconductor material and as a dye sensitizer. For example, it has been used as the material for making OLED [12], dye sensitizer in solar cells [13-14], TNT gases sensors [15].

Semiconductor materials such as $TiO_2$ have been widely used as photocatalysts for solar energy conversion [16] and for the photodegradation of organic pollutants [17]. However, solar energy reaching the surface of the earth and available to excite $TiO_2$ is relatively small and artificial UV light sources are more expensive. Therefore, recent efforts have been focused on exploring means to utilize effectively the cheaper visible light [18]. Sensitization processes resulting from photoexcitation of