

TiO₂/CuMnO₂ HETEROJUNCTION-BASED SELF-POWERED UV PHOTODETECTORS

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Abstract

Self-powered ultraviolet-photodetectors (SPVs) have been very studied lately because they have a great advantage, namely they do not need any external power sources, can operate continuously and independently and do not require high costs to produce them [1]. Over time, it was shown that metal oxide heterojunctions can facilitate photovoltaics for self-powered operation due to their built-in potential which automatically separates generated electron-hole pairs [2]. Therefore, various metal-oxide semiconductor materials (i.e., TiO₂, ZnO, CuO, and NiO) have been applied for different types of photovoltaic cells [3], but among them, TiO₂ was selected as the most desirable material for photovoltaic devices [4].

In this paper, FTO /n-TiO₂ /p-CuMnO₂ heterojunction based self-powered UV photodetector was successfully produced in this configuration for the first time. The development process presumes two phases: (a) the TiO₂ thin films deposition by the Doctor blade technique (n-type TiO₂) on the FTO substrate and, (b) the deposition of CuMnO₂ film by spin-coating method (p-type CuMnO₂) on the FTO/n-TiO₂ structure, respectively. The structural and morphological characteristics of the as-synthesized heterostructures are investigated by techniques such as X-ray diffraction, UV-Vis spectroscopy, scanning electron microscopy, energy dispersive X-ray and atomic force microscopy. The heterojunction characteristics of the TiO₂ and CuMnO₂ thin films deposited on the FTO substrate are being established by current-time analysis. Measurement of the current time in the dark and UV irradiation were performed to show the sensor response value. The responsivity in the self-powered mode was $2.84 \times 10^7 \text{ A W}^{-1} \text{ cm}^2$ and in the 1 V bias mode it was $1.82 \times 10^6 \text{ A W}^{-1} \text{ cm}^2$. Under UV illumination with an intensity of 0.1 mW/cm^2 a self-powered current of 14.2 nA was generated. The above results show that of n-TiO₂/p-CuMnO₂ transparent heterojunction device exhibited a self-powered ultraviolet photodetector with high sensitivity [5].

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