Fabrication of 5,10,15-Tris(Phenyl)-20-(4-Hydroxyphenyl) Porphyrin Sensitized n-Cu_2O Photodetector

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There has been an increasing interest in non-toxic, earth-abundant and self-powered materials in photodetector industry. This is largely because currently used materials are high toxic and high fabrication costs. Mostly, state-of-art photodetectors tend to use these toxic and rare earth inorganic materials due to their high performance. Even though, organic materials have the ability to reduce toxicity and fabrication cost, their optoelectronic and stability performance is still low. Hence, to addressing these drawbacks, an organic-inorganic hybrid photodetector was fabricated and characterized. Environmentally friendly n-Cu_2O layer was fabricated on top of Cu substrate and 5,10,15-tris (phenyl)-20-(4-hydroxyphenyl) porphyrin dye was used as an organic sensitizer. The device was fabricated by using atmospheric hydrothermal method followed by a step of immersing in the dye. The sensitivity and detectivity were calculated using IV characterization. The observed highest responsivity was 11.21 mA W^{-1} to blue (near UV, 465 nm) light at 0 bias. The sensitivity reached 6.601×10^3 and the highest detectivity of 2.182×10^{11} was observed under blue (465 nm) LED at 0 bias. The photodetector at its self-powered mode demonstrated fast rise and fall times of 862.9 μs and 855.6 μs at 35 kHz, respectively. These results indicate that the photodetector is more responsive toward near UV range with medium level stability. Furthermore, it can be concluded that Florine doped Tin Oxide/Cu/n-Cu_2O/5,10,15-tris(phenyl)-20-(4-hydroxyphenyl) porphyrin photodetector has considerable potential towards optoelectronic applications by having self-powered, green and low cost properties.

Keywords: Organic-inorganic photodetector; n-Cu_2O; porphyrin; green, self-powered