

Observing photovoltaic action in γ -CuI/Ga₂O₃ heterojunction with deep UV irradiation

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1. INTRODUCTION

Gallium oxide (Ga₂O₃) with a band gap of in the range of 4.5–4.9 eV is suitable wide band gap semiconductor for deep UV photodetector and power electronic device applications. β -Ga₂O₃ is a n-type semiconductor due oxygen vacancy which opens possibilities to fabricate a p-n heterojunction with a suitable n-type semiconductor. In this prospect, zinc blend γ -copper iodide (γ -CuI) a p-type semiconductor with bandgap of 3.1eV is good candidate to integrate with β -Ga₂O₃. Here, we report on fabrication of γ -CuI/Ga₂O₃ heterojunction which showed photovoltaic action under deep UV irradiation.

2. EXPERIMENTAL

CuI layer is deposited on β -Ga₂O₃ substrate using high vacuum thermal evaporation process at a chamber pressure of 6×10^{-4} Pa at current of 40 A for 20 sec. with substrate temperature of $\leq 50^\circ\text{C}$. Further, Gold (Au) and Indium (In) are deposited using high vacuum evaporation process as metal contacts for measuring J - V characteristics of γ -CuI/Ga₂O₃ heterojunction.

3. RESULT AND DISCUSSION

Figure 1 (a) shows schematic diagram of the fabricated vertical of γ -CuI/Ga₂O₃ heterojunction. Figure 1(b) shows the J - V characteristics under dark as well as UV light. A rectifying diode behavior was observed under dark conditions. Further, the device was tested under 254 nm solar blind irradiation as well as longer UV wavelength (365nm) and 300-400 nm UV light. Interestingly, a photovoltaic action is observed under all three different UV irradiations with open circuit voltage (V_{oc}) values of 0.706 V under 254nm UV light, 0.736 V under 365nm UV light and 0.77 V under high intensity 300-400 nm UV light. Figure 1 (c) shows the expected band diagram of γ -CuI/Ga₂O₃ heterojunction. Thus, the fabricated vertical γ -CuI/Ga₂O₃ heterojunction showed a excellent diode characteristics as well as excellent UV light induced photovoltage.

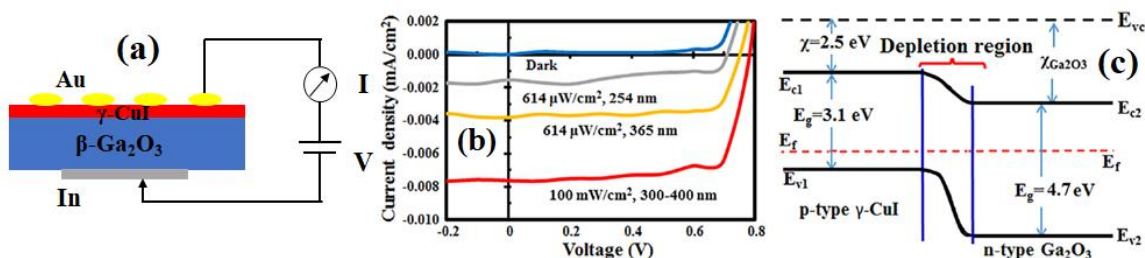


Figure 1 (a) Schematic diagram of fabricated γ -CuI/Ga₂O₃ heterojunction. (b) J - V characteristics under applied voltage of -0.2V to 0.8V showing photovoltaic action under UV light. (c) Expected band diagram of γ -CuI/Ga₂O₃ heterojunction.

4. CONCLUSIONS

In conclusion, we observed that fabricated γ -CuI/Ga₂O₃ heterojunction demonstrated diode characteristic along with photovoltaic action under deep UV irradiation (254nm) as well as under 365nm and 300-400nm irradiation.

References:

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