

# Temperature dependent ultraviolet photoresponsive behaviour in $\gamma$ -CuI/GaN heterojunction.

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## 1. INTRODUCTION

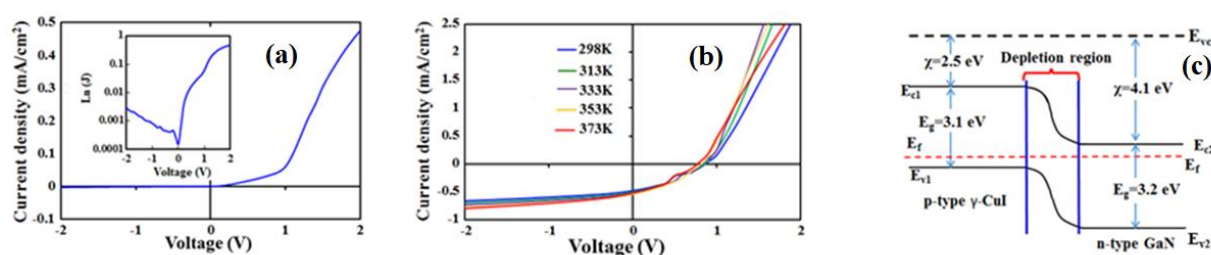
Due to excellent optical and electrical properties of Gallium Nitride (GaN) which possess a direct band gap of 3.4 eV has been extensively researched for various optoelectronic and power device application. GaN devices are especially critical as they can operate at high temperature, high output power and high frequency. GaN has already been integrated with various materials like graphene and TMDC's to form Schottky junctions and p-n and n-n<sup>+</sup> heterojunctions respectively. Likewise, zinc blend  $\gamma$ -copper iodide ( $\gamma$ -CuI) a p-type semiconductor with wide band gap (3.1eV) and excellent conductivity ( $>40 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$  in bulk) is a good candidate to form an effective wide band gap p-n heterojunction device with n-GaN. Here we report on fabrication of  $\gamma$ -CuI/GaN heterojunction and diode characteristics with a high UV photoresponsive photovoltage were elucidated with temperature-dependent transport behavior analysis.

## 2. EXPERIMENTAL

CuI layer was deposited on n-GaN substrate by high vacuum thermal evaporation process at a chamber pressure of  $6 \times 10^{-4}$  Pa. Further Gold (Au) and Indium (In) electrodes were deposited on  $\gamma$ -CuI and GaN, respectively, using high vacuum evaporation process. The device properties were investigated using two probe system at room temperature and elevated temperature (278-373K).

## 3. RESULT AND DISCUSSION

Figure 1a shows the  $J$ - $V$  characteristics for the fabricated  $\gamma$ -CuI/GaN heterojunction under dark conditions. A rectifying diode characteristic was obtained with a rectification ratio of  $10^2$ .  $J$ - $V$  characteristics confirm that  $\gamma$ -CuI/GaN heterojunction can be suitable as p-n junction diode. Under UV illumination ( $100 \text{ mW/cm}^2$ ) conditions the heterojunction showed photovoltaic action with an open circuit voltage ( $V_{oc}$ ) of 0.93 V and short circuit current density ( $J_{sc}$ ) of  $0.49 \text{ mA/cm}^2$ . A variation in photovoltaic action was observed with change in temperature (298~373K) as shown in figure 1b. Occurrence of photovoltaic action at a high temperature of 373K indicates that  $\gamma$ -CuI/GaN photoresponsive device have quite high operating temperature than other devices.



**Figure 1**  $J$ - $V$  characteristics (a) under dark condition for bias voltage -2V to +2V showing diode characteristics. (b) under UV light illumination for the fabricated  $\gamma$ -CuI/GaN heterojunction device with change in temperature (298~373 K). (c) Probable energy band diagram for the  $\gamma$ -CuI/GaN heterojunction device.

## Reference:

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