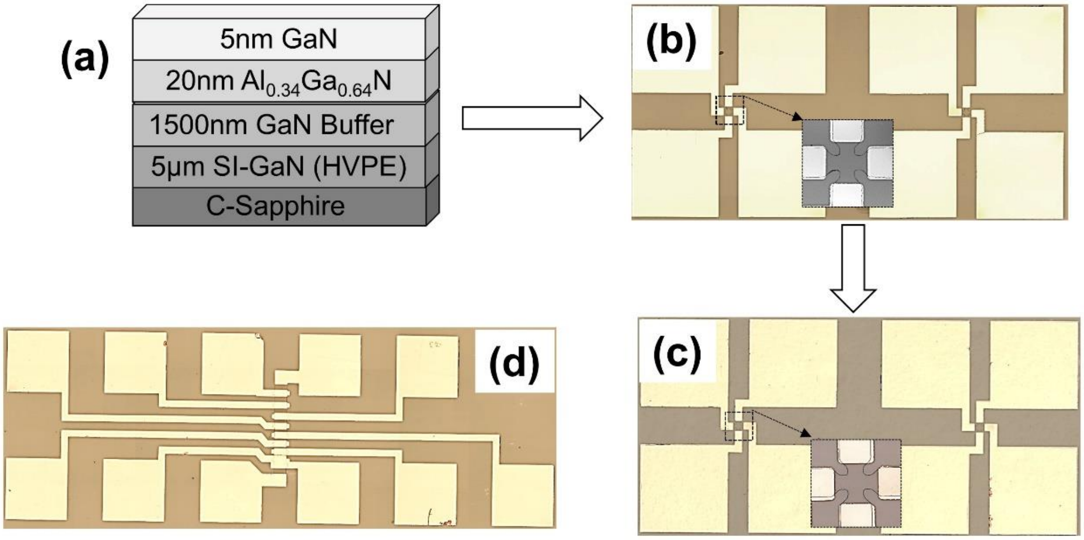
RESULTS AND DISCUSSION:

The $Al_{0.34}Ga_{0.66}N$/GaN microfabricated Hall sensor [**Fig. 1(b)**], where evaluation of the 2-DEG is achieved by investigating the Hall voltage which has direct influence on drift velocity of carrier, as a function of thermal aging time. Fabricated Micro-Hall sensor sensitivity tested under constant current and voltage bias mode for all thermal annealing protocol, corresponding data presented in **Fig. 2(a & b)**. The efficiency of $Al_{0.34}Ga_{0.66}N$/GaN micro-Hall sensor under thermal aging, we calculated the Absolute Sensitivity (S_A), of a Hall device is defined as the change in output Hall voltage (V_H) divided by the change in applied magnetic field (H) i.e., $S_A = G_H \frac{r_H}{qN_{2deg}} I_b --(1)$. Similarly, Supply Current Related Sensitivity (S_{scrs}) expressed as $S_{scrs} = G_H \frac{r_H}{qN_{2deg}} --(2)$, and Supply Voltage Related Sensitivity (S_{svrs}) can be defined as $S_{svrs} = G_H \frac{r_H}{RqN_{2deg}} --(3)$ which implies that $S_{svrs} = \mu_H G_H \frac{r_H}{\left(\frac{L}{W}\right)} --(4)$. From above relation, it is clear that current-related sensitivity (S_{scrs}) is inversely proportional to (n_s) and the voltage-related sensitivity (S_{svrs}) is directly proportional to electron mobility. The measured taken current-related sensitivity (S_{scrs}) were found to be 74 $VA^{-1}T^{-1}$ and 82 $VA^{-1}T^{-1}$ (SCRS), and voltage-related sensitivity (S_{svrs}) are measured to be 0.053 T^{-1} and 0.051 T^{-1} (SVRS) for pristine sample and after 2800 hours thermal aging at 200 ^oC in air. As we seen from **Fig. 2** there will be ~2% improvement in SCRS and ~2% change in SVRS of the Hall sensor after a prolonged baking times of 2800 hours at 200 ^oC. As expected, the Hall sensor has the ability to survive at 200 ^oC in air for an extended period of time. The slight increasing trend of SCRS and decreasing trend of SVRS with heating due to the combined changes in sheet carrier density and mobility ($n_s\mu$).

CONCLUSIONS:

We have investigated the temperature response of $Al_{0.34}Ga_{0.67}N$/GaN Hall sensors, in terms of the Hall sensitivity, and Ohmic contacts during thermal aging at 200 ^oC for up to 2800 hours under atmospheric conditions. The MBE grown $Al_{0.34}Ga_{0.67}N$/GaN Hall sensors were characterized by using HR-XRD, micro-Raman, and XPS on Hall sensor device before and after thermal aging time. To compare the performance of the Hall sensor we have correlated the structural evolution in $Al_{0.34}Ga_{0.67}N$/GaN Hall sensor heterostructures with measured electric response of Hall device. Results indicate that the $Al_{0.34}Ga_{0.67}N$/GaN Hall sensor provides stable performance for as long as 2800 hours aging at 200 ^oC without any significant degradation to the sensitivity, and Ohmic contacts. However, this study conducted for Hall sensor device does not have surface passivation, though we have noticed the out-diffusion of ‘Ga’ and ‘Al’ does not affect much on performance of the Hall sensor. Addition we have found initial stage of contacts resistance droop which could be due to out ‘Ga’ or Al diffusion process may be consequence of a reduction of oxygen concentration at the GaN/Ti interface resulting in a reduced contacts barrier height. The ‘Pt’ based ohmic contact enables bumpy free surface morphology after 800^oC RTA.

FIGURES:



No bumpy surface morphology after 800 °C RTA

Fig. 1. (a) Cross-sectional growth diagram of AlGaN/GaN Hall sensor, **(b)** Plan view of Greek-Cross Hall sensor device before RTA, **(c)** Plan view of Greek-Cross Hall sensor device after Ohmic contact after RTA annealing **(d)** TLM structure used for contact resistance measurement.

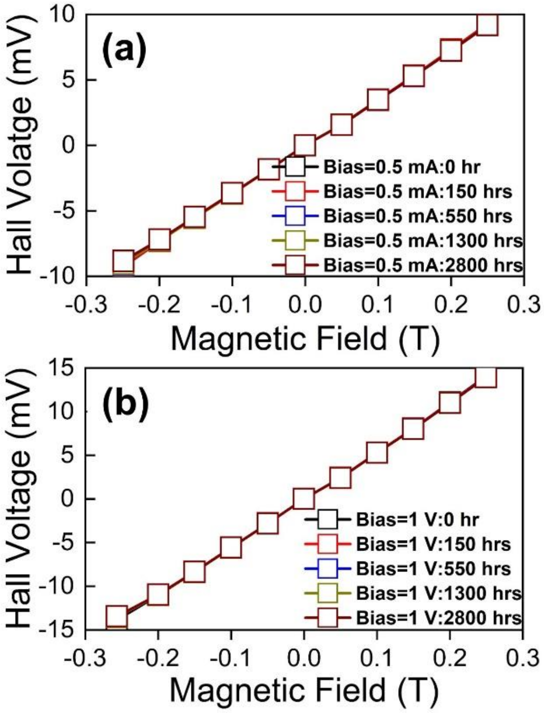


Fig. 2. Measured **(a-b)** Micro-Hall sensor have a linear response to magnetic field, both in current and voltage bias mode over a wide range of thermal annealing time at 200 °C in atmospheric condition.