# Improved characteristics for Metal-nGaSb Ohmic contact by using Indium Gallium Zinc Oxide (IGZO)

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**Summary**

We introduce an excellent Ohmic contact technique in n-type GaSb by using a thin (~ 5 nm thick) Indium Gallium Zinc Oxide (IGZO), achieving a high on-current density of 6.804 A/cm$^3$ and a low on/off-current ratio of 1.64 and also resolving Fermi level pinning problem near the valence band edge [1],[2]. A thin IGZO on n-type GaSb annealed at 500°C before metal deposition contributes to Ohmic contact formation because of two main causes; (1) InSb narrows the energy bandgap and (2) free Sb as traps induces tunneling current.

**Ohmic contact formation on n-type GaSb**

A thin (~ 5 nm thick) IGZO was deposited on Te doped n-type GaSb (concentration: 6 × 10$^{17}$ cm$^{-3}$) by RF sputtering and the sample was annealed at 500 °C for 1 hour in a $N_2$ ambient. Ni was then deposited on the IGZO by thermal evaporator (Fig. 1). Fig. 2 presents SIMS intensity profiles of n-IGZO/n-GaSb samples non-annealed and annealed at 500°C. In slowly diffused when compared to other atoms and the concentration of Sb showed the abnormal reduction near the surface of n-GaSb. Equilibrium composition simulation was also conducted by using HSC chemistry software to analyze SIMS intensity profiles in detail (Fig. 3). It illustrates dominant reactions as a function of temperature when In, Ga, Zn, O and Sb atoms are mixed under the same condition. In atoms easily reacted with Sb atoms, consequently forming InSb. Especially, since the possibility that Sb is released from GaSb rapidly increased above 300°C, it can be expected free Sb elements were re-distributed and reacted with In near the surface of n-GaSb. Fig. 4 shows J-V characteristics of Ni/n-GaSb and non-annealed/annealed Ni/n-IGZO/n-GaSb. The Ni/n-GaSb sample has Schottky junction property because of the Fermi-level pinned near valence band edge. The non-annealed Ni/n-IGZO/n-GaSb sample also shows Schottky junction behavior with a similar on/off-current ratio to Ni/n-GaSb sample, despite of the reduction of on-current density by n-IGZO acting as a tunneling resistor. However, Ohmic behavior was observed after performing 500 °C anneal, presenting on-current density which is similar to that of control sample.

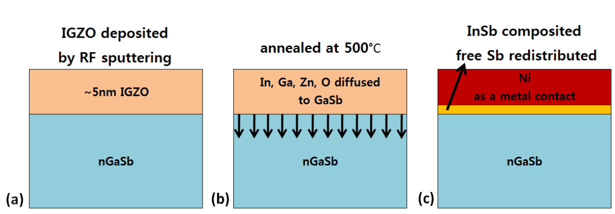


Fig. 1. Process flow and structure for I-V measurements

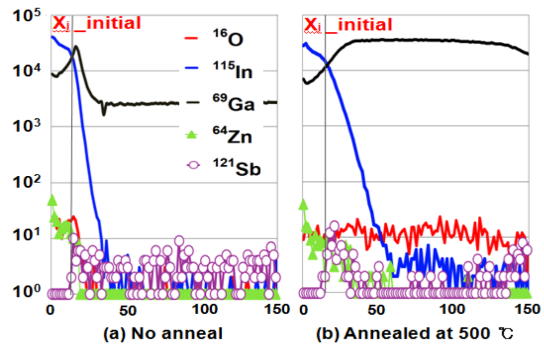


Fig. 2. SIMS profiles of IGZO on n-GaSb with no anneal and annealed at 500°C

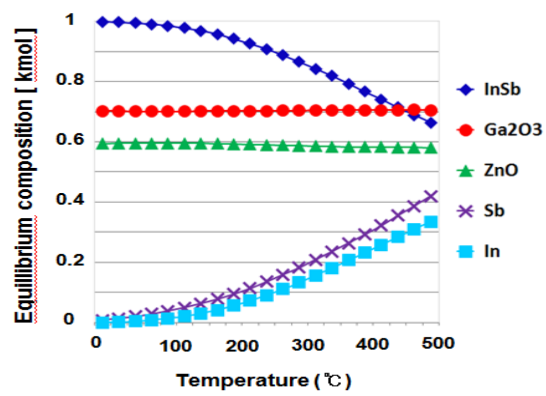


Fig. 3. Equilibrium composition calculated by HSC thermodynamics simulation program as a function of annealing temperature.

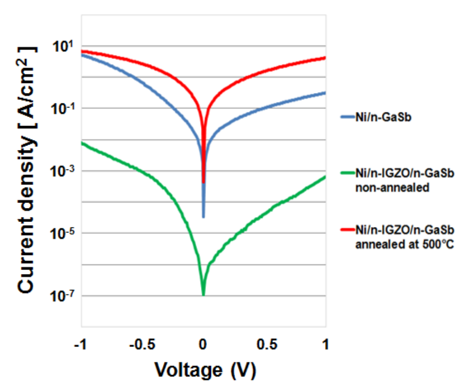


Fig. 4. Electrical Characteristics of the Ni/n-IGZO/n-GaSb samples non-annealed, annealed at 500°C and Ni/n-GaSb sample

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**References**

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