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Modification of Surface Optical and Electrical properties of bulk GaSb (100) resulting from a Sulphur- based chemical treatment

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Abstract content
   (Max 300 words)

GaSb is a versatile III-V semiconductor material and heterojunctions between GaSb and other III-V semiconductors show great promise as near infra-red (IR) lasers, light emitting diodes (LEDs), pollutant gas detectors, thermo-photovoltaic devices and photo-detectors in the wavelength regions 2-5 and 8-14μm [1,2]. Moreover, its lattice parameter renders it an excellent substrate for the epitaxial growth of ternary and quaternary III-V compounds such as (AlGaIn)(AsSb) and superlattice structures [1,3]. The surface of GaSb is highly reactive, resulting in a native oxide (Ga-O and Sb-O) layer. These low integrity oxides have impeded the development of GaSb based devices.
This study reports on an alternative chemical "passivant" for stabilizing the GaSb surface by treating it in a sulphur blended [(NH₄)₂S0₄/(NH₄)₂S] solution. Scanning Electron Microscopy (SEM) of the treated surfaces displays a significant improvement in the surface morphology over that of the untreated material. Additionally, step profiling revealed that sulphurization causes a non-linear time dependent etching effect accompanied by smoothening of the bulk GaSb (100) surface while the photoluminescence (PL) intensity was enhanced three-fold. Current-voltage (I-V) characteristics of Au/n -GaSb schottky structures improve as a result of chemical treatment as evidenced by a higher barrier height and an ideality factor that approaches unity. The reverse leakage current however does not saturate, probably due to either tunnelling or near surface recombination via surface states which are not passivated (or removed) by the sulphurization. The surface state density (Nss) distributions within the bandgap were calculated from the forward IV characteristics of the device.

 References

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