



Contribution ID: 36

Type: not specified

Gallium Oxide pn heterojunctions using RF-sputtering on p-type substrates

Wednesday 28 January 2026 10:30 (15 minutes)

Gallium oxide (Ga_2O_3) is an ultra-wide bandgap semiconductor with strong promise for high-voltage power devices and solar-blind UV photodetectors, but its practical deployment is constrained by low thermal conductivity and, most critically, the lack of reliable p-type doping. A common route around this limitation is heterointegration, where n-type Ga_2O_3 is combined with established p-type semiconductors to form anisotype pn heterojunctions.

This work combines a focused review of Ga_2O_3 material drivers with a preliminary fabrication study of sputtered Ga_2O_3 thin films and high work function Ni/Au contacts deposited on p-Si, p-GaN, and p-diamond using RF and DC sputtering. SEM revealed smooth films on Si and GaN, while films on diamond replicated the substrate roughness. RBS with SIMNRA fitting yielded near-expected Ga:O ratios on smooth substrates and thicknesses in the 150 to 200 nm range, but indicated limitations for rough substrates. Electrically, Ni/Au behaved ohmically on diamond but remained highly resistive on p-GaN, motivating post-metallization annealing. Future work will include XRD phase identification, improved RBS modeling, PIXE impurity quantification, systematic annealing sweeps, and photoconductivity measurements under UV illumination.

Field of Research/Work

Condensed Matter and Materials

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