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Formation of structured low-ohmic p-type contacts on Al-implanted 4H-SiC by laser annealing

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Motivation and aim of this work

- State of the art: Use of structured Al-Ti contacts as p-type ohmic contacts with subsequent RTA step
- Use of laser treatment for p-type contacts largely unexplored
- Development of a metal layer sequence for p-type contacts for laser treatment
- Development of a method to protect thermosensitive layers from damages by laser treatment
- Manufacturing of structured Ti-Al based ohmic contacts on p-type 4H-SiC using laser annealing



Processing

Fabrication of TLM structures on commercial 150 mm 4H-SiC epitaxial wafers



TLM test structures in top view



R(d) plot of an exemplary TLM test structure for different energy densities



40 50 60 70 90 90	159 248 1.4 J/cm ²	40 50 60 76 80 90 580 2 E	9 J/cm ²
ALLER	CAREAR ARCAR		
410 30 610 40 90	$\frac{100}{201/cm^2}$	60 70 80 90 460 240 3	2 $1/cm^2$

Determined specific contact resistivity and sheet resistance depending on energy density

Discussion

- Sheet resistance independent of energy density
- Minimum contact resistance for 1.9 and 2.0 J/cm²
- High standard deviation for 2.2 J/cm² caused by misalignment during laser processing

Microscope images of lasered TLM structures after wet chemical etching of unreacted AI-Ti

Summary

- Manufacturing of p-type ohmic contacts by laser annealing using Ni-Al-Ti metal stacks
- Use of metal stack as a self-aligned mask to protect thermosensitive layers from damages by laser annealing
- Further work necessary like AFM measurement, TEM analysis and XRD measurements to determine the formed compounds

1 T. Kimoto and J. Cooper. Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices and Applications, IEEE Press, Wiley, Singapore (2014).

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