The degradation of ohmic contacts to 4H-SiC sensors over time at high temperature is primarily caused by two dominant failure mechanisms: migration of bond pad Au and atmospheric oxygen toward the ohmic contact/SiC interface; and the inter-metallic mixing between diffusion barrier systems (DBS) and the underlying ohmic contact metallization. We have investigated the effectiveness of Pt/TaSi₂/Pt/W and Pt/Ti/W DBS in preventing Au and O diffusion through the underlying selected W:Ni [1] and Ti/W [2] ohmic contacts to 4H-SiC up to 700 °C.

Summary and Conclusion

- For the Pt/TaSi₂/Pt/W DBS on both the W:Ni and Ti/W ohmic contacts, FIB-FESEM revealed the transformation of the surface morphology to one that was densely populated with sub-micron solid globular features, identified to be a Au-Si eutectic phase. The Au-Si eutectic at the surface acts as a nucleation site for the oxidation of Si, which then extends 300 nm into the Au layer. This oxidation of the Au-Si eutectic at the top surface will degrade the mechanical and electrical integrity of the contact after wire- or flip-chip bonding.
- For the Pt/Ti/W DBS on both W:Ni and Ti/W ohmic contacts, the Au layer remained free of O diffusion. The surface morphology remained smooth and minimal zonal intermetallic mixing was observed.
- Further evaluation of the Pt/Ti/W DBS on Ti/W ohmic contact at 700 °C after 5 hours and 12.5 hours showed little change in the intermetallic mixing zones. The microstructural characteristics also remained unchanged and no evidence of atmospheric oxygen migration through the contact metallization.

Acknowledgement

This work was performed under the NASA Transformational Tools and Technologies Project and funded by the Transformative Aeronautics Concepts Program of the Aeronautics Research Mission Directorate. The authors thank Dr. Amir Avishai of Case Western Reserve University School of Engineering for the FIB-FESEM images.

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