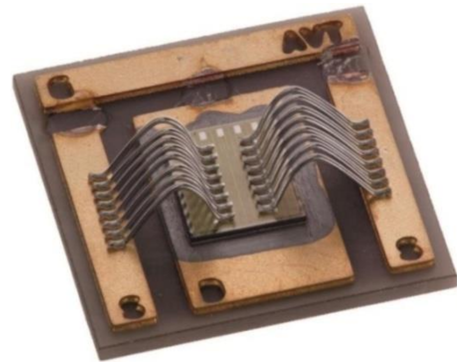
IMTEK

Master Thesis

Power cycling of assembled GaN high electron mobility transistors (HEMTs)

Modern RF generators are based on Si-based electronic devices, which are very often failed due to high power reflections. The operational limitation of these devices is up to 200 ˚C, whereas the application requires that the devices must withstand instantaneous temperature rise up to 500 ˚C, coming due to sudden impedance mismatch. State-of-the-art GaN high electron mobility transistors (HEMTs) are the future replacement for Si devices. GaN belongs to the class of III-V semiconductors with properties suitable for high-temperature and high-power operation. There are still issues with the development of reliable assembly and packaging techniques for GaN HEMTs. Both die-attachment and interconnection are required to fulfill following key properties. The devices must retain electrical properties after assembly process. They assembly must exhibit good thermal dissipation behavior and it is required to survive 500 °C in failure case. The ultimate goal is to increase reliability as compared to the existing assembly techniques.

Both die-attachment and interconnection are the focus of the research work. Silver sintering and transient liquid phase (TLP) bonding are developed as die-attachment techniques for the packaging of GaN devices. Moreover, gold and palladium based wire bonding process is selected as interconnection method. The characterizations for high temperature operation for these die-attach and interconnection techniques have already been performed. The present work aims at reliability studies for these assembly techniques. The focus will be given to the active power cycling of GaN assemblies.



RF transistor (IXYS) attached onto an AlN DCB using transient liquid phase die-attachment

Following tasks have to be performed during the thesis work.

- Development of GaN assemblies using the already developed die-attach and interconnection techniques at our laboratory.
- Passive temperature cycling of the assembled devices
- Optimization of power cycling setup
- Power cycling of the assembled devices with different ΔT_j (Junction temperatures)
- An initial estimation of the reliability of GaN assemblies

For further information regarding the topic please contact

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