Die Attach and Bonding Recommendations

Introduction
While Nitronex’s core market is packaged RF products, we sell die to select customers for use in modules and subsystems. One benefit of Nitronex GaN devices is they are fabricated on industry standard silicon wafers so industry standard die attach and wire bonding procedures can be used. This application note describes typical procedures that have been successfully used by Nitronex in engineering and production environments and are guidelines for our die customers. As with all semiconductor assemblies, appropriate qualification should be performed to ensure a reliable process is being used.

Die Attach Recommendations
Most Nitronex die have air bridges and other sensitive structures on the top of the device that can be damaged if excess force or stress is applied to the top side of the die. Ensure that the tooling used during die attach does not damage these structures.

The backside of Nitronex die are terminated with a Au layer to provide a good thermal and electrical interface and allow flexibility in methods of die attach. Recommended methods of die attach are:

- AuSi Eutectic
- AuSn Eutectic
- Ag-Filled Epoxy

AuSi Eutectic Attach Process
1. Place substrate, chip carrier, or heatsink on a heated work surface at 420°C - 430°C.
2. Pick die using a 2-sided or 4-sided collet.
3. Place die on top of heated substrate with 60g - 100g force (depending on die size).
4. Scrub die approximately 3mils in line with the short dimension of die for 10-15 cycles.
5. Remove substrate with die attached from heated work surface as soon as possible. A delay of more than 5 seconds may compromise through-wafer vias if present.
6. Best results are achieved on an automated die bonder with Nitrogen or forming gas surrounding the part during bonding.
7. Die should never be exposed to temperatures greater than 430°C or held at this maximum temperature for more than 20 seconds.

AuSn Eutectic Attach Process
1. Place substrate, chip carrier, or heatsink on a heated work surface at 250°C.
2. Pick and place a AuSn preform (80/20 composition), approximately the same size as the die, on to the substrate.
3. Pick and place die on top of preform and hold down with 40 - 80g force.
4. Ramp temperature from 250°C to 300 - 320°C in approximately 10 seconds.
5. Dwell for 4 to 6 seconds.
6. (Optional) Scrub die approximately 3 mils in line with short dimension of die for 10-15 cycles.
7. Ramp temperature back down to 250°C and remove substrate with attached die from heater.
8. Best results are achieved on an automated die bonder with Nitrogen or forming gas surrounding the part during bonding.
9. Different die bond tools can be used including: 2-sided collet, 4-sided collet, and rectangular surface pick-up tool.

**Ag-Filled Epoxy Attach Process**
1. Apply epoxy to bond site in desirable pattern and proportion.
2. Press die into epoxy.
3. Oven cure with recommended temperature profile for specific epoxy being used.
4. Best results are achieved on an automated die bonder with epoxy dispense capability.

**Wire Bond Recommendations**
No active devices or other metallization is present under Nitronex bond pads. All bond pads are terminated with a Au layer to facilitate both ball and wedge wire bonding. Al wire should not be used as this can create intermetallic growth with the Au bond pads.

**Ball Bonding Process**
1. Place the ball on the die and the crescent bond on the circuit to minimize the force applied to the die.
2. Heat substrate with die to 130 - 150°C during wire bonding.
3. Select appropriate size wire to allow for ball size and wire bond placement accuracy on bond pads. Bonds should not overhang the outside of bond pads to avoid contact with exposed metallization from other areas of the die.

**Wedge Bonding Process**
1. Bonding may be done in any order with first bond, stitch bond, or last bond placed on die.
2. Heat substrate with die to 130 - 150°C during wire bonding.
3. Select appropriate size wire to allow for bond, tail, and wire bond placement accuracy on bond pads. Bonds should not overhang the outside of bond pads to avoid contact with exposed metallization from other areas of the die.