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#### **TestConX Korea 2023**

### Obstacles and Challenges on Economic SiC Power Burn-In Process

#### Gabriel TAK Technical Product Marketing



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열화 Degradation Normal Life Wear-out Bat 제작 완료 비스트 결과 중석



Since the development of electronic devices, the world has been undergoing rapid and efficient evolution. Among various fields, a crucial aspect currently facing us is "power semiconductors." SEMICS, as a global semiconductor manufacturing equipment company in Korea, we want to discuss the existing problems and explore potential alternatives within this realm.

Currently, many global power semiconductor chip manufacturers are striving to achieve the demanded level of quality while establishing efficient mass production systems. Our company, SEMICS has put considerable effort into contemplating the value we can provide to our customers and has been working on developing solutions that can meet all requirements. One of the outcomes we are proud of is an efficient and versatile solution for the Wafer Level Burn-In (WLBI) process, which is at least one of the challenges faced by engineers today.

This technology focuses on addressing the issues in the current WLBI process of SiC / GaN wafers and solving associated research tasks through SEMICS' unique approach. We believe you will understand how we can efficiently and accurately measure the status of die and generate valuable data to feedback front SiC wafer process for definitive improvement.

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#### Contents

- SiC & GaN WLBI Challenges on various aspect
- Potential methods for mass production of SiC & GaN WLBI in various, different environments
- Integration Options Into ATE Test System
- Conclusion & Next Challenges





### SiC & GaN WLBI Challenges on various aspect



### SiC & GaN WLBI Challenges on various aspect

Environmental Concerns	Technical Concerns
<ul> <li>Optimization of Test process WLBI</li> <li>BI Time (1hour ~ 24hours)</li> <li># of Wafers per Day</li> <li>Size &amp; Cost of Test System</li> <li>Test environment</li> <li> Products <ul> <li>Products</li> <li>Redage +</li> <li>Corrent Rating +</li> <li>Redage +</li> <li>Corrent Rating +</li> <li>Redage -</li> <li>Redage -<th><ul> <li>Make High Voltage Test System smaller</li> <li>Tester's Maximum Channels vs Wafer gross die roadmap</li> <li>Individual Operation Capability (Recipe program, Test flow per test slot) and Individual DUT measurement Capability(Vth, IGSS, IDSS, RDSON and etc)</li> <li>Good Temperature Uniformity &amp; Ramp up/down time</li> <li>Design of Optimized Tester, Handler</li> <li></li> </ul></th></li></ul></li></ul>	<ul> <li>Make High Voltage Test System smaller</li> <li>Tester's Maximum Channels vs Wafer gross die roadmap</li> <li>Individual Operation Capability (Recipe program, Test flow per test slot) and Individual DUT measurement Capability(Vth, IGSS, IDSS, RDSON and etc)</li> <li>Good Temperature Uniformity &amp; Ramp up/down time</li> <li>Design of Optimized Tester, Handler</li> <li></li> </ul>
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Potential methods for mass production of SiC & GaN WLBI in various, different environments • Current WLBI methods.	
Individual BI system approach	Multiple BI system approach
<ul> <li>Advantages:</li> <li>Operation can be automated to manage lots.</li> <li>Flexible, good to increase test parallel to decrease BI touch downs</li> <li>Downtime/Failure is only limited to one system/slot</li> </ul> Disadvantages: <ul> <li>Need spacious test area for BI</li> <li>Cost is high</li> <li>Operation cost will be high</li> </ul>	<ul> <li>Advantages:</li> <li>Number of wafers out per area is high</li> <li>Cost is low</li> <li>Operation cost will be low</li> </ul> Disadvantages: <ul> <li>Mostly oven is manual approach</li> <li>Multi system mostly lose individuality</li> <li>Impact caused by system failures is huge</li> <li>Maximum parallel will be limited</li> </ul>
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## Potential methods for mass production of SiC & GaN WLBI in various, different environments

• Individual BI approaches. 16 systems=16 slots (BI Tester, Prober, Hinge)



Area: 169m²(13m x 13m) BI: 12 hours Wafer/day: 32ea \* Without handling time

Figure-1. Typical WLBI test floor



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# Potential methods for mass production of SiC & GaN WLBI in various, different environments

• Individual BI approach vs Multiple BI approach.



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#### Potential methods for mass production of SiC & GaN WLBI in various, different environments

#### • Idea is simple

- Do not trade off the value between individual BI system and multiple BI system. Put them all together first.
- Operation can be automated to manage lots. → Make the system full automated system.
- Flexible, good to increase test parallel to decrease BI touch downs. → Maximize Tester channel and bring ideas to have this real.
- Downtime/Failure is only limited to one system/slot. → Make the system modular and let it has individuality.
- Cost is low.  $\rightarrow$  There is no reason to be more expensive than individual system.
- Number of wafers out per area is high. → This is natural consequences if the system is well-designed.
- Operation cost will be low. → This is natural consequences if the system is well-designed.
- Make the system to suite to the concept & idea well is absolutely difficult.



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## Potential methods for mass production of SiC & GaN WLBI in various, different environments

• To realize the idea, the development of the following key modules is necessary.



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#### Chuck & Temperature control



Automaton handler



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### Potential methods for mass production of SiC & GaN WLBI in various, different environments

• Compact and easy maintenance concept of Tester for HTGB BI, Individual Die's IGSS, IDSS, Vth measurement capability up to 4096DUT.



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### Potential methods for mass production of SiC & GaN WLBI in various, different environments

 Chuck & Temperature control & Uniformity control modules per each Tester. (@150°C within ±1.0°C, @175°C within ±1.5°C)



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## Potential methods for mass production of SiC & GaN WLBI in various, different environments

• Handler brings wafers to each individual test system under the fully automated system control environment.



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### Integration Options Into ATE Test System

Individual Test system module 34ea

Chuck with direct

control module

34ea

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contact Temperature



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Fully automated

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loader system

Embedded inline tester calibration probe card



Advanced software UI both for Tester and Handler (SECSGEM)



OHT & AGV ready wafer cassette port

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X 5 speed

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#### **Integration Options Into ATE Test System**

 Individual BI approaches. 16 systems=16 slots (BI Tester, Prober, Hinge)



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 Multiple BI approaches. 4 systems=136 slots (BI Tester, Prober, Hinge)



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Multiple BI system approach
<ul> <li>Handling time: Consider as zero for easy calculation</li> <li>BI time: 24hours</li> <li>Area for operation: 169m<sup>2</sup> (13m x 13m)</li> <li>Number of system: 4ea x 34slots = 136ea</li> <li>Wafer per day: 136ea</li> <li>Wafer per month: 4,080ea</li> </ul>

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#### **Conclusion & Next Challenges**

- Based on your SiC & GaN BI process and method, the most suitable system structure can be varied. But at least, we need to think about to stack or to arrange side by side without giving up individual BI system's advantages.
- We hope the system can be used on both of WLBI and EDS in the future.



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