National Multi-User Silicon Carbide (MUSiC) Research and Fabrication Facility at the University of Arkansas

MULTI-USER SILICON CARBIDE
Semiconductor Research and Fabrication Facility

Implementing Big Ideas with NSF Mid-Scale Support

Why A National Facility?

It is a national priority that the US lead in research and development of SiC high-power devices and SiC integrated circuits, and systems. MUSiC is the new national facility that can help to make that happen. The importance is that the country that leads in advancing semiconductor design and fabrication will also lead in the race to market nearly all new game-changing economic and military technologies. Even more unique is that this facility will be located on a university campus in order to make it accessible to potential users of all types.

This SiC facility is a driving force for a very broad range of applications and is analogous to how a silicon foundry addresses and continues to address a vast array of vehicles for transportation, communication and sensing electronics systems as well as all military weapons and defense systems.

Impact of MUSiC

(1) MUSiC at the University of Arkansas (UA) will be an "open" research facility.
(2 It will be the only facility of this type in the US and the consequence will have a growing national impact.
(3) American researchers with exciting design ideas for novel SiC based circuits, devices, and systems, no longer have as their only choice to contract foreign firms to fabricate their designs and test new concepts.
(4) SiC circuits, which are essential for power electronics, can become available for research on emerging technologies.
(5) The research community can develop and provide access to secure and leading-edge semiconductors for defense and critical infrastructure systems.
(6) MUSiC will help prepare the next generation of researchers with the ingenuity and innovation skills needed to lead the US in the global competition for new SiC semiconductor circuits & devices.

MUSiC Capabilities

MUSiC will be researcher-ready instrumentation facility for the SiC research and enterprising community. The scope of the proposed facility with respect to size and power of the components to be produced is:

- SiC integrated circuit technologies such as 0.5micron SiC CMOS technology, JFET technology and bipolar technology
- Medium-voltage and high-voltage SiC power devices such as diodes, MOSFETS and IGBTs
- SiC sensors and interface electronics
- Optoelectronic devices and interface circuits
- Other wide bandgap materials processing
- Compatible Si processing capability
- Able to transfer technology with external partners
- The process modules will be compatible with those of large industry so that once low volume prototyping is available it can be used as the start of what industry needs for high volume

Additional Resources

High Density Electronics Center (HiDEC) @ UA

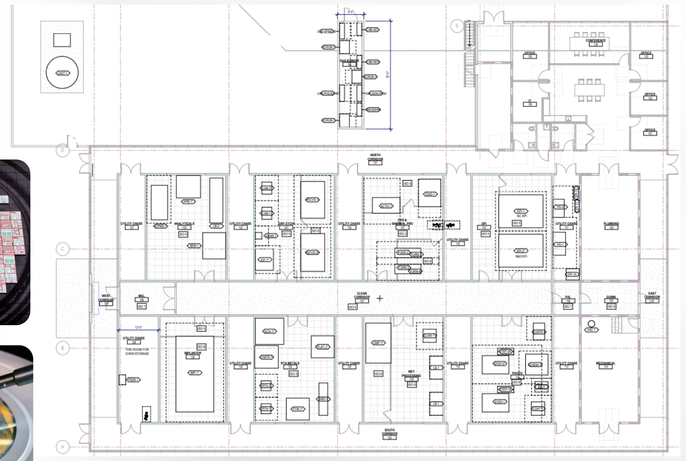
- Over 30 years' research and user-facility model for power packaging facility, closely work with industrial partners such as Wolfspeed, Rohm, Toyota, etc.

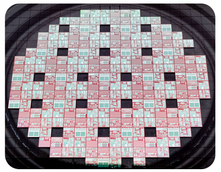
Low temperature co-fired ceramic (LTCC) prototyping capability @ UA

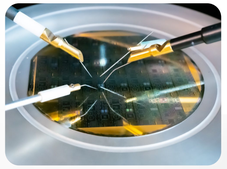
- Ceramic-based electronic integration using conventional GreenTape chemistries (Dupont 951/ 9K7 & Ferro A6/L8) with either Au or Ag as well as high temperature co-fired ceramic (Ferro 44007/44009) with Pt metallization

Key Features of the Facility

- Low volume prototyping to serve R&D needs of industry and academe in a way not currently possible.
- Facility will utilize 6-inch SiC wafer
- Class 10-100 cleanroom environment
- Sub-micron SiC CMOS process flow
- High-voltage SiC power device fabrication flow
- Highly skilled team of researchers and engineers
- Customizable solutions for defense, academic, and industry applications
- Development of the next generation of engineering talent and workforce development that is so needed in the semiconductor industry. The training of students at all levels of degree completion.



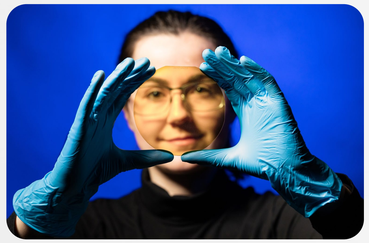




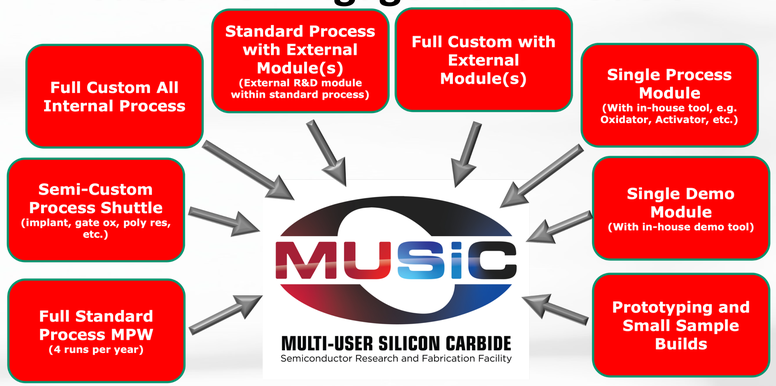
Risk and Change Management

Keep a full balance between technical and operations in order to be aware of risk and change that should be implemented.

- This involves regular analysis of the financial and technical progress of the program.
- Regular analysis of the customer service provided and the regular operations in terms of smooth progress of the customer services and adjusting the operations practices to fit the needs of the facility's ability to provide efficient services.
- It is inevitable that any facility will develop operations and practices. Following these and the suggestions made by NSF as continued support for managing our risk and change will help determine what shifts can be made to create for the most successful facility possible.



Customer Engagement Models



Best Practices – Risk and Change Management

- Do not trust the PEP you wrote for your proposal.
- As soon as you are funded, start rewriting the PEP. You will already have ideas about what to change.
- Immediately set up a virtual or in-person meeting with your NSF RIO Officers from both the technical and the financial perspectives of the program as well as that of the facility development.
  - These individuals have excellent suggestions that you have most likely overlooked in your proposal. You can't think of everything.
  - They also have a lot of experience and are likely to see things you would not.
  - The NSF Mid-Scale officials will provide excellent ideas regarding changes to your staff structures and this made a significant opportunity for our project to move along far more smoothly.
- Another important element to support the facility is to be sure you have more than just one main strategic body for feedback. Since there will be customers it is very important to:
  - Develop a local advisory board made up of local users who can provide feedback
  - Develop an external advisory board made up of customers who are external to your local area. These organizations can give feedback as to how they are treated as customers.
- Effective communication from those who can help is an important first step toward managing risk and change on the project because it will mitigate some of the need for additional changes in these areas.

Additional Best Practices

Organization Communications

- An extremely important element for the UA team has been the communication between the team and upper administration regarding the plans for the facility.
- Transmit instructions and suggestions provided by the Mid-Scale team.
- Explain feedback collected from both local and external customers.
- In this fashion, the team is working to communicate fully to confirm and maintain support for the facility, while also addressing concerns in regular time intervals.
- This communication leads to ideas about risks and change management.
  - This is in addition to the day to day detailed implementation of such plans.

MUSiC
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