MISSION & SCOPE

MASH Mission & Scope

MASH will support the CHIPS and Science Act to enhance America's strength in semiconductors and microelectronics and promote economic development.

The goal of MASH is to create the world's largest nanofabrication, packaging, and characterization facility by linking and enhancing the facilities in the region. The MASH "distributed" network of facilities will support technology transition to manufacturing and offer redundancy of resources and immediate access to a huge amount of technical expertise in semiconductors.

MASH will focus on helping the semiconductor industry to transition materials into systems, which is a critical industrial need of many emerging applications such as advanced communications, non-volatile memory, More than Moore devices, Industrial Internet of Things, artificial intelligence, edge computing, wireless communications, quantum devices, environmental sustainability, and materials and substrates.

MASH activities will center around three cross-cutting areas: Si-adjacent technologies, advanced packaging, and virtualization of semiconductor processes.

MASH will develop skills-based educational and workforce development plans to provide companies with an agile system to meet staffing requirements, and at the same time, enhance racial and socioeconomic diversity.

MASH will be a hub for regional and national activities to promote professional education and training, educate the public on semiconductors and microelectronics, share and coordinate materials standards, identify funding opportunities, and build networks and technology road maps.

MASH Mid-Atlantic SEMICONDUCTOR HUB

PRINCETON UNIVERSITY

Princeton University offers top-of-the-line scientific research facilities that welcome both external and internal users. Three of the largest core facilities are housed within the School of Engineering and Applied Sciences (SEAS). A central mission of the SEAS core facilities is the education, research, and training of students. These core facilities are part of Princeton Materials Institute, a premier center for materials science and education due to its unique integration of long-term, curiosity-driven research, high-impact innovation, and long standing engagement with industry. At these core facilities the user can fabricate, integrate, and characterize a range of materials.

MNFC: fabrication

MICRO/NANOFABRICATION CENTER

The MNFC is a ~ 18,000 sqft clean room with ISO 5, 6 and 7 space. The MNFC has over 70 processing and metrology tools and had over 200 users from internal and external academics, government, and industry. Our partnership with the state of New Jersey has provided a low entry barrier for start-up companies eligible for state funding to use these facilities. In 2022-2023, seven new start-up companies in the area accessed the MNFC and Packaging lab through this mechanism.

The MNFC provides 2,600 sqft clean space for a dedicated undergraduate teaching lab: students learn what is inside a microchip, how they work, and how they are made, providing hands-on integrated circuit microfabrication for diodes and MOSFETs.

ISO 5 space houses E-beam lithography (patterning to < 10 nm, up to 6 inch samples, e.g., superconducting quantum devices), direct laser writing and a dedicated SEM metrology tool.

ISO 6 space contains various plasma etching tools (Si, III-V, diamond, metals) and deposition tools (ALD, CVD, PVD), a range of thermal processing equipment, various characterization tools (for metrology with rapid processing inspection in mind), and a number of fume hoods and wet benches.

ISO 7 space is dedicated to the soft materials processing space, e.g., PDMS microfluidic device processing. This lab houses a tabletop direct laser write system, degassing ovens, curing ovens, plasma cleaners, and parylene coater. There are also a variety of 3D printers, including system that can produce 3D polymer structures with feature sizes from sub-micron to the millimeter scale for applications such as cell scaffolding and custom nano-needle processing.

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FACILITIES

PACKAGING LAB: back-end integration

MNFC PACKAGING LAB
The Packaging Lab is the largest growing core facility, with a suite of upgrades underway and the fastest growing user base of our cores. Tools include: dicing, scribing, cleaving, wire bonding (wedge, ball), flip-chip bonding, lapping and polishing. Examples of current work include (i) detector build technology at CERN (ATLAS, CMS), (ii) build of the giant six meter $100M CMB telescope at the Simons Observatory, and (iii) photonic sensing capabilities (interfacing with neural-networks).

This facility not only provides these back-end processing tools for users but handles bespoke work for academia, government and industry. Current upgrade projects are (i) installing an Indium evaporator for low temperature fine pitch 3D chip on chiplet integration, (ii) installing an automatic fluid dispensing robot and fine wire wedge/ball bonders.

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IAC: characterization

IMAGING AND ANALYSIS
The IAC has over 300 users per year (including 65 external organizations) and is the largest core facility in New Jersey for advanced characterization. The 7,500 ft^2 labs meet NIST's highest standards for environmental control (EMI, vibration and isolation). The IAC contains three SPMs (including a low temperature q-Plus AFM/STM capable of imaging molecular orbitals and measuring the force required to break a single chemical bond), two FIBs, two SEMs, Micro-CT, XRD, SAXS, TGA/GC/MS, Rheometers, DSC, UV-Vis, Raman, XPS, Ellipsometer, Optical microscopy with IR spectral mapping. A world-leading center for microscopy, it boasts five TEMs, some capable of imaging to <1 Å, and two cryo-EM machines.

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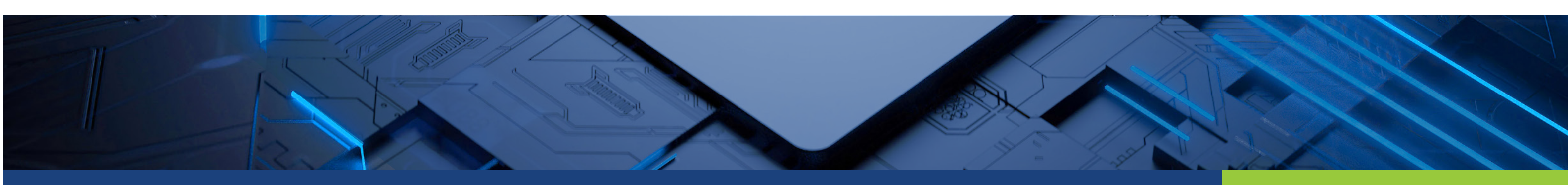

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