CHIPS Act : Semiconductor Manufacturing Science and Technologies
Room 207 A W - Session CPS+MS-MoA

Semiconductor Manufacturing Workforce Development

Moderators: Erica Douglas, Sandia National Laboratories, **Timothy Gessert**, Gessert Consulting

1:30pm **CPS+MS-MoA-1 Workforce Development in the Semiconductor Industry: A New National Approach***, **Michelle Williams***[1]*,* SEMI Foundation **INVITED**

To fulfill its promise to grow to $1 trillion as soon as 2030, the semiconductor industry will need an estimated 1 million new workers. Addressing this challenge will take a whole-of-industry, nationalized approach bolstered by significant federal and state investments. It will also require a fundamental rethinking of employer approaches to attracting, recruiting, and retaining a far broader workforce that represents the widest possible range of perspectives, backgrounds, and ideas so the industry can continue to innovate, problem solve, and thrive.

The SEMI Foundation is the workforce development arm of SEMI, the global industry association representing the microelectronics manufacturing and design supply chain with more than 3000 members worldwide. We know that accomplishing this work requires three strategies: we must illuminate and demystify the semiconductor industry for students and jobseekers; we must provide clear educational pathways into the industry; and we must provide access to hands-on training to prepare the workforce.

This keynote address will illuminate a new national approach on how to employ these strategies and weave them together to help galvanize a new generation of workers and create economic opportunity in communities proximate to semiconductor companies across the nation. Attendees will walk away with concrete and timely opportunities for their companies to engage in workforce development networks and activities to bolster their own success.

2:15pm **CPS+MS-MoA-4 Bridging the Talent Gap: Advancing Workforce Development for the Manufacturing and Semiconductor Industries***, **Sue Smith**,* Smart Automation Certification Alliance

The rapid advancement of technology and growing global demand for semiconductor components have placed unprecedented pressure on the U.S. manufacturing sector to expand and innovate. The landscape of geopolitics along with supply chain challenges have added to the mounting pressure. However, a widening skills gap combined with a shortage of an estimated 1.9 million manufacturing workers is most threatening to the industry's ability to meet this demand. This presentation addresses the urgent need for robust, scalable workforce development strategies tailored specifically to manufacturing and semiconductor manufacturing. Drawing on industry input, standards, and credential development, we will explore how partnerships among industry, government, and educational institutions can catalyze talent pipelines. The session will highlight successful case studies, outline key competencies for next-generation workers, and propose an ecosystem-based approach to building a resilient, diverse, and future-ready workforce. Attendees will gain actionable insights into curriculum innovations and collaborative models that can drive sustainable growth in one of the nation's most critical sectors.

The Smart Automation Certification Alliance (SACA) collaborates with partner companies in the manufacturing sector to develop credentials in Industry 4.0 and emerging technologies based on international standards supporting the attainment of certifications and demonstrated competencies. These credentials are being used by employers, secondary and post-secondary education, and training providers in developing the workforce for current and future skills needed in the workplace.

To effectively bridge the talent gap in the manufacturing workforce, particularly in emerging technologies like semiconductors, credentials will play a key role in an ecosystem-based approach. There are industry, government, and education partnerships having success in workforce development with SACA and other industry recognized credentials. More innovation and participation in collaborative models will drive sustainable solutions to addressing the skills gaps and meeting the demands for the growth in semiconductor production and advanced manufacturing. Development of standards by and for industry assures the appropriate skills and knowledge are identified and the attainment of aligned credentials develops the talent needed.

2:30pm **CPS+MS-MoA-5 Partnership of Research University and Technical College for Microelectronics and Nanomanufacturing Workforce Development***, **Seung-Joon Paik**, Yu "Michelle" Wu,* Georgia Institute of Technology*; Jameel Hasan,* Georgia Piedmont Technical College

A partnership has been established between the Georgia Institute of Technology, a research university with advanced nanomanufacturing facilities, and Georgia Piedmont Technical College, a technical college with regional professional education capabilities, aiming to address the nationwide demand for a workforce to build a talent pipeline for the semiconductor industry. Through this partnership, military veterans and their relatives are trained in a microelectronics and nanomanufacturing certificate program. The certificate program has achieved a completion rate of over 85% through 600+ hands-on lab hours using 20+ different pieces of equipment since 2022.

The U.S. semiconductor industry is projected to face a shortage of 53,200 engineers and technicians by 2030 due to the evolving demands of the industry according to The Semiconductor Industry Association. While many workforce development efforts are being invested to build education and training ecosystem, there are obstacles to overcome to accommodate workforce into the industry. Semiconductor fabrication or Nanomanufacturing facility has unique environments and requirements such as enclosed cleanrooms with stringent temperature, humidity and vibration, and head-to-toe covering cleanroom suit. Hands-on practices and proper training are crucial for enriching learning experiences and effectively applying job skills.

The Institute for Matter and Systems (IMS) at Georgia Institute of Technology is equipped with state-of-the-art nanofabrication machines and tools in a 28,500-square-foot space. Through the core facilities of cleanroom and material characterization, IMS offers hands-on training in lab safety, nanomanufacturing, and characterization to users. The capabilities include photolithography, thin film deposition, etch, and metrology, which are widely used techniques in high-tech nanomanufacturing industries and research facilities. Georgia Piedmont Technical College works as a hub of training opportunities for regional workforces in advanced manufacturing industries. The college engages military veterans in training programs for high-demand industries and implements education curricula and teaching methodologies in microelectronics and nanomanufacturing.

This presentation highlights a strategic partnership effort for workforce development in microelectronics and nanomanufacturing focused on veterans. Formation of partnership, modifications of curriculum, and hands-on experiences enriching students learning experience will be discussed. Key components involve successful approaches, lessons learned, and future access expansion.

2:45pm **CPS+MS-MoA-6 an Accelerated Bachelor's Degree in Semiconductor Materials and Devices***, Susan Farhat,* Department of Chemical Engineering, Kettering University*; Ronald Kumon, Daniel Ludwigsen, Uma Ramabadran, **Cornel Rablau**, Ronald Tackett, Demet Usanmaz, Lihua Wang,* Department of Natural Sciences, Kettering University

Kettering University, a STEM-focused private university in Michigan, is gearing up to launch an Accelerated Bachelor of Science degree in Semiconductor Materials and Devices that is designed to address one of the major hurdles in bringing semiconductor manufacturing back to the United States: a shortage of skilled workers. With the current strain on the global supply chain, and the CHIPS and Science Act injecting billions of dollars into bringing semiconductor manufacturing back to the US, the demand for highly-skilled professionals with semiconductor-industry-relevant training is skyrocketing. Funding for the development of this program has been obtained through a Strategic Investment Grant from the Michigan Economic Development Corporation (MEDC) intended to bolster Michigan's technological workforce. Kettering University has also become one of the participating schools under the MEDC-supported Michigander Scholars program to bolster workforce preparation in Michigan's high-tech sectors. The skill set required for a career in the semiconductor industry is inherently interdisciplinary, and this degree program reflects this, as it has elements from physics, chemistry, and engineering. In this talk, we will present the motivation behind this degree, the plan of study itself, and the reasoning behind why it was constructed in the manner in which it was.

[1] **Workforce Development Keynote Lecture**

3:00pm **CPS+MS-MoA-7 Building a Regional Education and Workforce Development Infrastructure for Semiconductor Manufacturing***, **Robert Geer,*** NY CREATES **INVITED**

The large-scale federal investments aimed at reasserting U.S. leadership in the global semiconductor industry has created an urgent need for a skilled IC design and manufacturing workforce. However, a significant talent gap threatens these goals. Addressing this need requires a comprehensive approach, currently underway, to build the education and workforce development infrastructure to support the semiconductor industry.

The Semiconductor Industry Association estimates that the industry will need to add more than 100,000 jobs in the U.S. to support planned or announced projects. Revitalizing the semiconductor talent pipeline requires a holistic approach. Nearly half the chip fab workforce will enter the industry with a high school diploma, 2-yr degree or non-credentialed training (e.g. military service). The remainder will be dominated by B.S./M.S./Ph.D. engineers, computer science, and research/development professionals. Addressing the challenges of preparing such a broad talent pool requires a combined national/regional strategy to address overall career awareness and engagement, modernization of training and education programming to address key skill and knowledge gaps, and targeted initiatives to reduce the 'time-to-productivity' for new hires.

A case study of this 'national/regional' strategy will be presented focusing on the new chip fabs under construction in the northeast U.S which will require tens of thousands of highly trained technicians, engineers, and data professionals over the next decade. The coordination of national initiatives (including the new National Semiconductor Technology Center in Albany, NY, regional DoD Microelectronics Commons Hubs in the northeast U.S. and Manufacturing U.S.A. institute investments) with regional (state-wide) efforts with in-depth analysis of competency profiles for semiconductor manufacturing will be reviewed in terms of maturing the region's workforce and educational ecosystem to support chip-fab expansion. Key components involve broadening the requisite competency base across the higher education network through industry-aligned curriculum modernization, expanded access to experiential learning in leading edge facilities, expanded adoption of 'learn and earn' opportunities and coordination with national awareness campaigns. Central to this strategy is the role played by industry organizations and regional development nonprofits as a 'connective tissue' to support the overall talent pipeline.

3:30pm **CPS+MS-MoA-9 Workforce Development Opportunities in a University Nanofabrication Core Facility***, **Megan Dernberger**, Benjamin Schmidt, Christina McGahan, Sarah Ross, Sharon Weiss,* Vanderbilt University

In Vanderbilt Institute of Nanoscale Science and Engineering (VINSE) at Vanderbilt University, several programs are successfully implemented to engage students, postdocs, and external users of VINSE in workforce development. Programs include workshops, an Industrial Affiliates Program (IAP), and part-time student employment. These programs are mutually beneficial to staff and users, reducing the time burden for full-time staff while also promoting users' technical, teaching, and leadership skills. This talk highlights lessons learned with the development of these programs.

The VINSE IAP fosters collaborative relations with industry leaders. This program allows students and faculty direct access to industry contacts for recruitment, job opportunities, and networking events. The industry members can sponsor workshops with technical trainings, interactive Q&A sessions, and content tailored to the userbase. Utilizing connections with VINSE alumni and a modest entry fee to create a low barrier to entry resulted in over 15 IAP members in the first year.

Additionally, VINSE offers staff-led short courses to the internal and external community. The one- or two-day events provide a hands-on introduction into topics and technical skills for users. Topics include microfluidic device fabrication, semiconductor device fabrication, electron microscopy, and atomic force microscopy.

Undergraduate and graduate students can be directly involved in VINSE for months to years through the VINSE Undergraduate Tech Crew and SuperUser programs respectively.Tech Crew undergraduates, ~14, assist staff with cleanroom upkeep and process development. They specialize in various tools and processes, gaining hands-on experience and exposure to a wide range of nanoscience applications. Students can join Tech Crew during an intensive 10-week summer program or the academic year. A three-level tiering system acknowledges skill and leadership development with promotions in title, pay, and responsibilities.Graduate student SuperUsers, ~5, are selected based on technical and interpersonal skills and assist with highly-used cleanroom equipment. They provide initial tool training to users and initial troubleshooting of tool issues on a subset of tools, building teaching experience and deeper tool knowledge. As an incentive, SuperUsers have increased access to VINSE staff, extra training on selected tools, and a professional development stipend.

These workforce development programs are highly successful for fostering interdisciplinary relations, increasing technical skills, and enhancing the nanoscience research community at Vanderbilt.

4:00pm **CPS+MS-MoA-11 Challenges of Infusing Vacuum Technology into Two-Year Technology Programs***, **Elena Brewer,*** Erie Community College

With the recent revival of semiconductor manufacturing in the United States, the industry is challenged with the lack of a qualified technical workforce to meet the rapidly growing demand for technicians.Vacuum technology has a special place of being an enabling technology for the semiconductor industry and other industry segments.Thus, the availability of technicians prepared to work with and troubleshoot vacuum-based systems is essential for the semiconductor industry.This presentation will address the challenges encountered by SUNY Erie Community College and Normandale Community College, and present corresponding solutions to overcome these challenges.The main three challenges in teaching vacuum technology at the community college level are: lack of institutional expertise, lack of available training equipment, and lack of technician-level educational resources in vacuum technology.SUNY Erie has been tackling these challenges since 2014 when ECC's Nanotechnology AAS program was first introduced. Since then, vacuum technology has been infused into the Electrical Engineering Technology AAS program, and a standalone Vacuum Technology micro-credential was developed. Normandale Community College has been working on providing educational solutions in Vacuum Technologies even longer and offers vacuum technology training at various levels using different modes of course delivery, including interactive remote-access vacuum instruction. This presentation will highlight the educational resources developed over multiple NSF ATE grant projects that are available for community college and technical college faculty, such as: an eBook in Vacuum Technology; laboratory manual and instructor's guide to support experiential learning in Vacuum Technology; rough and high vacuum technology training equipment; and current and future professional development opportunities for community college and technical program faculty.

4:15pm **CPS+MS-MoA-12 Review of AVS Educational Outreach Activities in the Context of the Chips in Science Act and its Related Workforce-Development Needs***, **Tim Gessert,*** Gessert Consulting LLC

The AVS has provided various types of education opportunities to its members and others since the mid 1960's. One important component of these activities has been public and private *short courses*on topics consistent with the needs of various high-technology sectors. Indeed, for many technologists, engineers, and scientists now working in these high-tech industries, their initial exposure to areas such as basic vacuum technology, vacuum-process development, and characterization, often began with an AVS Short Course. In the mid 1980's, AVS education outreach expanded to include training high-school teachers through the *AVS Science Educators Workshop* (SEW). Through this activity, many hundreds of high-school teachers throughout the U.S. have received not only basic vacuum training, but also a working vacuum system designed for the needs of a high-school classroom. In addition to the SEW helping these teachers convey the extensive uses of vacuum processes in many industries, another goal of the SEW has always been to help "spark" student interest in considering post-secondary education (i.e., college), and possibly even toward an STEM career involving vacuum technology. Recently, and encouraged by the realities of COVID, many AVS education outreach activities now also include the option for virtual training, including virtual short courses, webinars, and You-Tube videos that can often align better with changing workplace and workforce needs. Additionally, in partnership with the American Institute of Physics (AIP), the AVS is now actively exploring how to better provide this type of education outreach to communities that have been historically underrepresented in the high-technology sectors.

In this presentation, the past ~60 years of AVS experience with educational outreach will be briefly reviewed, emphasizing how these ongoing activities and experiences might be leveraged to benefit the workforce development needs of the Chips in Science Act. It will also be discussed how, while the workforce of the future US Semiconductor Workforce will certainly require many skilled individuals with advanced academic degrees, this future workforce will continue to require many individuals with hands-on technology skills in areas such as process development/optimization and

equipment operation/maintenance. Because of the long-term AVS experience with training involving all these different workforce sectors, it is believed that much of the established AVS education outreach activities can significantly benefit the activities related to the Chips in Science Act.

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