

Nomination of Dr. Michael Khbeis for the AVS Excellence in Mentoring Award

Director, UW NNCI Washington Nanofabrication Facility

Summary of scientific/engineering accomplishments:

Dr. Khbeis's research has been focused primarily on high density electronics integration and high-speed systems. He spent 10 years in the Research organization for the US Department of Defense developing 2.5D 3D, and flexible heterogeneous packaging capabilities. From these efforts, several tech transfers were completed including die depackaging, thermal management for 3D systems including a patent on the use of thermal vias, die thinning, sub-micron through silicon vias (TSVs), and other related packaging technologies. His doctoral work was focused on multi-modal energy harvesting, with specific contributions on hybrid piezoelectric/electrostatic vibration scavenging. These energy harvesters also doubled as broad spectrum, low frequency acoustic sensors. More recently, his research has been on very high density TSV arrays, magnetic sensors, and integrated passive devices (IPDs) for 5G telecommunications.

Summary of mentoring and guidance to a significant number of persons who might not otherwise have considered or had access to opportunities in science, engineering and technology:

As Director of the Washington Nanofabrication Facility (WNF) and senior personnel for the University of Washington (UW) Northwest Nanotechnology Innovation (NNI) node for the National Nanotechnology Coordinated Infrastructure (NNCI) program, Dr. Khbeis helps lead workforce development and Education & Outreach (E&O) activities. This is a multifaceted effort spanning K-12 persons with an emphasis on improving diversity in the semiconductor industry and related fields.

For their youngest audiences, his group has conducted several STEM outreach events that have impacted over 15,000 regional students in the past year, including major events like Nano Day in October 2017, Engineering Discovery Days on the UW Campus, and regional high school STEM nights. In addition, his group conducted K-5 demonstrations of thin-film plasma etch and deposition with our focus on exciting kids about science by tailoring our content dynamically to meet them at their level of understanding. Yes, kindergartners can understand things like diffraction, plasma physics, thin-films, and phase change and temperature-volume relationships when explained in creative ways. He also gives dozens of tours each year of the WNF facility and raises awareness, to their visitors, of the area of nanofabrication. One reoccurring tour group are students from Melissa Baker's Nanotechnology course at Newport High School in Bellevue, WA. Mrs. Baker's class has created a pipeline of highly-engaged STEM student that come to UW wanting to pursue nanofabrication. Dr. Khbeis is currently collaborating with Mrs. Baker and Dr. Dan Ratner (UW BioE) on disseminating Mrs. Baker's lab content into kits that can be shipped to underserved communities. Looking at the huge disparities in

opportunities for collegiate access and preparation in the region, his group is doing everything they can to lower access barriers which is critical for improving diversity in the field and in admissions to the UW. They hope that the kits and the process of training educators in underserved communities will help improve the pathways from those communities to the universities.



Another initiative his group is focused on is workforce development. They continue to grow the WNF's undergraduate research assistant program, currently with 22 undergraduate students and another 7 interns from regional colleges, with over 30% of the participants being women and underrepresented minorities. These research experiences are a multi-year engineering apprenticeship where the students begin by learning to work in a cleanroom setting, aid in housekeeping and stocking activities, but quickly graduate to running machine and process qualifications. They then rapidly progress to assisting on Internal Research and Development (IRAD) activities and complete their time with us by aiding in contract manufacturing or research prototyping. The more than 100 participants that have gone through this program have all obtained jobs in the semiconductor field or pursued graduate school. Starting in 2017, they expanded this program to reach First Nation tribal communities, starting with a paid summer intern program for recently graduating high school seniors that join the UW summer student cohort and assist in college preparatory efforts to help bridge the students with higher education opportunities while providing another path to improving college education affordability by offering a permanent position while they continue undergraduate studies. His is group is currently expanding this activity to other regional tribes as well as Pacific Islanders.

Students participating in this program prepare a poster for the annual Undergraduate Research Symposium where they present their work to a broad audience.

In 2017, Dr. Khbeis founded Womxn in Nanotech and Science seminar series, that brings women and gender diverse individuals to speak to students on campus about life in “the real world”. This series differentiates itself from technical talks by focusing on dealing with real-life issues and challenges when entering the workforce as persons from diverse backgrounds. In all, Dr. Khbeis has promoted and emphasized the creation of a diverse and well cared for group of talented scientists and engineers that go on to contribute to industry and academia in meaningful ways.



Biography:

Dr. Michael Khbeis is the Director of the Washington Nanofabrication Facility (WNF). He served as both Director of Operations and Acting Director of WNF since 2011, where he oversaw a radical transformation that brought the lab from the verge of a death spiral, to a thriving community of academic researchers and over 100 companies, growing revenues by 400% in less than 5 years. This transformation was enabled by a \$37 million phased and occupied renovation that Dr. Khbeis helped design, plan, and execute. The renovation was completed in October 2017 and brings an ISO Class 5 certified cleanroom to the UW campus; enabling the next 20 years of nanofabrication capabilities. Prior to UW, Dr. Khbeis' research was on enabling technologies for 2.5D/3D integration and flexible electronic systems for the Department of Defense. Exemplar technological developments include novel low-profile packaging, plasma activated covalent bonding, and high aspect ratio sub-micron through silicon vias for high density interconnect and patents for stacked

systems thermal management. In order to develop these capabilities, he managed, designed, and oversaw construction or renovation of 3 cleanroom laboratories and specified, acquired, installed, and commissioned over 40 major semiconductor fabrication and advanced packaging tools. As a technology mission leader, serving as Research and Engineering Division Chief (2009-2011) and Branch Chief (2005-2009), he was one of the youngest researchers to achieve executive grade in his Agency. Dr. Khbeis obtained his PhD in Electrical Engineering in 2010 (U of MD), MSEE in 2007 (U of MD), and BSEE in 2001 (UW). His academic research was focused on ambient vibration energy scavenging using microelectromechanical systems (MEMS). Finally, as an undergraduate, Dr. Khbeis worked full-time while attending school as Semiconductor Process and HAZMAT technician for Matsushita Semiconductor Corp of America (MASCA aka Panasonic), so 2018 marks his 21st year in the semiconductor industry.