Power Electronics Campaign

The New York State Center for Advanced Technology in Nanoelectronics and Nanomaterials (CATN2) Matching Investment Program (MIP)

The CATN2 completed six competitive funding rounds under the CATN2 Matching Investment Program (MIP) to support faculty-led projects and expand SUNY Poly's R&D and commercialization capabilities in collaboration with New York State-based companies. Total awards under this program have totaled $1,431,787, with industry and other partners providing $5,273,038 in additional resource commitments for a total program investment of $7,165,825 to date resulting in a 5 to 1 match.

The faculty-led, industry driven research projects at SUNY Poly's College of Nanoscale Science and Engineering have focused on areas in the power electronics have totaled $900,000 with $600,000 being funded by NYS companies. The following projects that support the CATN2's power electronics campaign in the area of Power Switching, including principal investigators, total project budget, New York industry partner, and summary of the research to be undertaken:

Project title: Determination of Failure Modes of MEMS Contacts and Development of Techniques to Mitigate these Failures
NY-PEMC Campaign Thrust: Power Switching
Principal Investigator (PI): Carl Ventrice
Private Entity Partner: Menlo Microsystems
MIP Award: $70,505
Total Project Budget: $235,105
Summary:
Power semiconductor technology is enabling electrification across a wide range of applications, from transportation to power generation. At the heart of this technology advancement, wide-bandgap (WBG) power semiconductors, SiC and GaN, are replacing their Si counterparts as the power device of choice at higher power levels. Consequently, power conversion systems (PCS), within the transportation sector, for example, benefit from power electronics composed of packaged WBG devices, such as SiC JBS diodes and MOSFETs or GaN HEMTs.

Industrial partner Menlo Microsystems is reimagining one of the most fundamental building blocks of electronic systems – the electronic switch. Menlo is developing the core technology around fused silica based substrate fabrication, metal MEMS and hermetic through glass vias (TGV) and beginning the early phases of product commercialization of its MEMS based switch products. To continue the technology's advancement to higher power levels, the various reliability and failure mechanisms must be thoroughly understood and quantified. *The goal of this collaboration is to characterize the behavior of a ruthenium-based film with a grown ruthenium oxide top layer across various environments and temperatures to assess the stability of the Ru/RuO2 layers. This bi-layer material stack serves as the electrical contact for the switch, which experiences electrical, mechanical and environmental failure mechanisms.*

Project Title: MEMS Switch Reliability
NY-PEMC Campaign Thrust: Power Switching
Principal Investigator (PI): James Lloyd
Private Entity Partner(s): Menlo Microsystems
MIP Award: $75,000
Total Project Budget: $280,100
Summary:
Power semiconductor technology is enabling electrification across a wide range of applications, from transportation to power generation. At the heart of this technology advancement, wide-bandgap (WBG) power semiconductors, SiC and GaN, are replacing their Si counterparts as the power device of choice at higher power levels. Consequently, power conversion systems (PCS), within the transportation sector, for example, benefit from power electronics composed of packaged WBG devices, such as SiC JBS diodes and MOSFETs or GaN HEMTs.

Menlo was established as a spin-out from GE's Global Research Center with the goal and purpose to commercialize a breakthrough MEMS based ohmic switch technology and products. The company is reimagining one of the most fundamental building blocks of electronic systems – the electronic switch. The goal of this collaboration is to characterize and then improve upon the reliability and lifetime of Menlo's MEMS switch technology for both RF and power relay applications. Through the application of fundamental reliability and surface/interface physics the core failure modes (contact wear, electromigration, temperature induce material properties changes, etc.) will be characterized and modeled, baseline performance quantified, process and material improvements suggested, and reliability properties understood to enable the technology's expansion into additional markets in communications infrastructure and Industrial IoT.

Impact: While achieving a better understanding of the reliability of the MEMS switches, Dr. Lloyd's lab will be upgraded with new probe cards and other improvements that will be determined through the course of this project. Once Dr. Lloyd's team learns about the failure mechanisms they can determine what is needed to characterize those failure mechanisms. These improved capabilities will allow Dr. Lloyd to collaborate and support other CNSE faculty as well as NY based industrial partners.