

GOMACTech 2023 Technical Topics

We seek contributions from government, academia, and industrial organizations in a broad set of critical technology areas supporting government microcircuits applications. Authors are encouraged to review the technical topic area descriptions and submit to the area most closely aligned with their contribution. If you are unsure which technology area to submit to, please contact the GOMACTech 2023 Technical Program Chair, Luciano Boggione, at luciano.boggione@nrl.navy.mil

#1 Radiation-Hardened Technologies, Designs & Systems

Papers are sought detailing R&D work related to advancing the state of art in radiation hard microelectronics in the following areas

- **Radiation-Hardened Technologies and Systems** featuring research on current rad-hard technology programs, including captive IC processing, rad-hard fabrication through trusted commercial foundries, and manufacturing innovation. Also of interest are rad-hard systems under development for DoD applications and radiation test guidelines for critical applications.
- **Radiation-Hard Characterization Methods and Mechanisms** featuring research on novel radiation-hard characterization methods, basic mechanisms of radiation effects in novel nano-devices, and research on developing atomic-scale understanding of radiation effects and in atomic-scale defects. Methods of interest include but are not limited to electrically detected magnetic resonance and laser induced quantification of SEE effects.
- **Radiation Hardened by Design (RHBD) Electronics Research**, from an applied design perspective. Research areas of interest include design tools for sub-100nm technologies, radiation mechanisms and mitigation in high-speed analog and mixed-signal circuitry, and scalable RHBD techniques.
- **Rad-Hard and Space Applications** including all aspects of computing in the space radiation environment from high reliability critical control applications to high throughput data processing. Subjects can include all aspects of space processing from traditional radiation hard by process and design through software fault tolerance and real number parity calculations.

#2 Trusted, Assured & Cyber-Secure Microelectronics

Papers are sought describing novel techniques for measuring and verifying trust, assurance, and cyber security; and defining, creating, and establishing thresholds and confidence in trust or assurance of microelectronics products. Particular areas of interest include verification and validation techniques for detecting tampering, exploitation, and counterfeiting in microelectronics products, novel techniques for preventing and being resilient to malicious actions and counterfeiting in the microelectronics supply chain, embedded cyber security solutions and integrated software/hardware cyber-secure electronics. Programmable systems are also of particular interest, including vulnerabilities in programmable microelectronics as well as new approaches to monitoring and protecting programmable products and their features against exploitation. Finally novel techniques that can be applied to diagnose potential exploitations, confirm actual counterfeits or tampering, and develop evidence of the origin of anomalies and intent of adversaries and techniques that can be used to effectively screen for these exploitations.

#3 RF Technologies, Components & Systems

Papers are sought in the field of RF technologies from low frequency to mm-wavelengths and beyond, with particular emphasis on microsystem design and characterization of:

- Reconfigurable and self-healing electronic circuits
- Phased arrays, beamforming, on-chip antenna integration
- High-efficiency and broadband high-frequency power amplifiers, with emphasis on thermal design and management
- Heterogeneous integration of process technologies implementing novel, complex on-chip functionalities
- Systems-On-a-Chip supporting Simultaneous Transmit And Receive (STAR) systems
- Mixed signal circuits, high-speed data interface and transport between chips networks

Contributions in areas tackling new challenges and/or demonstrating new capabilities in the RF technology field are also welcomed.

#4 EO/IR Technologies, Components & Systems

Papers are sought in the area of EO/IR technologies, components, and systems. This area of research entails the development of electro-optic hardware that supports government-related applications such as infrared countermeasures, passive imagers, LADAR concepts, and EO/IR characterization systems. Relevant component technologies include infrared focal plane arrays, read-in and read-out integrated circuits, lasers, beam-steering concepts, and integrated assemblies.

#5 High-Performance Digital & Mixed-Signal Technologies

This area embraces digital and mixed/signal integrated microsystems including next-generation technologies such as AI and deep learning solutions, especially those not covered elsewhere in this document (e.g., RF Technology or Packaging & Integration topic areas). Papers are sought that detail advances in the design and development of digital and integrated mixed-signal integrated chip solutions to meet the ever-increasing needs of DoD applications such as 5G, autonomy with high performance, and low-power requirements. Novel digital circuits and circuit design techniques, components including ASICs, FPGAs, custom circuits, microprocessors and microcontrollers, and technologies that facilitate advanced digital design are of interest. In the mixed-signal domain, major advancements in one or more of a set of critical parameters like functionality, speed, bandwidth, frequency, power, dynamic ranges, etc. in highly miniaturized chip-scale substrates are of interest. Submissions detailing advances in design techniques and methodologies, devices, circuits, or entire chips, including upstream- and downstream-related technology areas (like design validation and test) are also of high interest in this technical area.

#6 Power Electronics & Emerging Power Technologies

Papers are sought covering all aspects of research and demonstrations of new power electronics including materials development, novel devices, and new circuits and systems. Submissions are encouraged in the areas of

- Wide- and ultrawide-bandgap material development, device characterization such as GaN, SiC, Ga₂O₃, AlN, and Diamond
- New pulsed power electronics demonstrations
- Wireless power transfer, and novel power distribution architectures

#7 Photonic Technologies

Papers are sought dealing with Photonic Technologies describing novel demonstrations of optoelectronics to enhance or replace electronics for critical government applications. Photonic technologies span Radio Frequency (RF), analog, and digital domains. RF photonics is attractive for signal transmission and processing in sensors systems due to benefits of light weight, low-loss, wide bandwidth, and high frequency over conventional electronics. Particular areas of interest include RF photonic phased-array beamforming, antenna remoting, and signal processing (e.g. RF up/down conversion). Advances in robust and rugged optical interconnects and integration with electronics for government applications are of interest.

#8 Packaging, Integration, Thermal & Control Technologies

Papers are sought detailing novel results related to microelectronics' post-fab technological work on integration, advanced packaging, and thermal management.

"Integration" work refers to technologies that can be used to seamlessly combine different types of integrated circuits, including but not limited to 2.5D, 3D integration, interposers.

"Packaging" refers to the broader technology area of assembling chips into completed assemblies including materials, processes, and any type of innovative interconnections.

"Post-fab technological work" embraces efforts in advancing new types of cooling and thermal solutions for a diverse array of chips needed for defense applications, including but not limited to GaN amplifiers and high-performance 3D computer chips.

#9 Emerging Technologies

Papers are sought describing emerging devices and technologies to enhance current government microsystem applications and meet future national defense and security requirements. Emerging technologies are a critical enabler for new information, signal, and data processing capabilities of the future: they include, but are not limited to,

- New concepts, devices, and components for integrated photonics, quantum information S&T, quantum sensing S&T, quantum communications
- Neuroelectronics to include neuromorphic concepts, devices, and circuits; bioelectronics sensors and flexible electronics
- New concepts, new devices, and new circuits beyond Moore's Law such as novel 3D technologies and heterogeneous integration of novel devices, hetero-epitaxial devices, carbon-based electronic devices, and spintronic technologies (spintorque, spin-wave, etc.)

Advanced material development, processes, and new manufacturing approaches for the devices and circuits of this technical topic area are to be submitted to the technical topic area on Advanced Materials & Processing.

#10 Advanced Materials and Processing

Advanced materials and processing approaches provide the catalyst for enhancing existing technologies, enable the use of current technologies in new ways, and are central to pioneering new technological areas. In particular, government systems seek advanced materials that lead to breakthroughs in the RF/millimeter/THz regimes. Likewise, beyond-Si materials for radiation-hardened electronics, and power electronics are sought after. These materials may include but are not limited to:

- Ge, III-V, GaN, diamond, AlN, oxide semiconductors
- Materials for extreme electrostatic control including carbon nanotubes, graphene, black phosphorous, and transition metal dichalcogenides

Understanding novel materials-driven phenomena such as phase-changes, spin transport/lifetime, etc., are also of interest for future government systems. Additionally, novel processing approaches have recently enabled the integration of dissimilar materials/devices onto a single substrate forming hybrid systems. This compilation of materials and devices gives rise to novel systems with enhanced performance that may also be flexible, soft, and potentially transient, thereby broadening their range of government system applicability.

Contributions to this technical area are expected to describe fundamental investigations. Advancements that apply to the materials and processes pertinent to this technical topic area should be submitted to the closest matching technical topic area, including Emerging Technologies, if none directly applies.