

## CNM WK7: Ultrawide bandgap materials for microelectronics

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There is growing demand for developing energy efficient devices that can work at extreme environmental conditions and ultrawide bandgap materials beyond silicon carbide and gallium nitride including diamond are considered as the best candidate materials due to their exceptional electronic and thermal properties. However, there are several fundamental challenges such as large area growth in single crystal form, low defect density, efficient doping, and seamless integration with other materials, that still needs to be solved in order to exploit their real potential. Solving these fundamental challenges will require an in-depth understanding of materials at the nanoscale including the ability to visualize defects at the atomic scale, understanding heterojunction interfaces at the nanoscale for their effective integration, and so on. Having access to novel and powerful characterization techniques down to atomic scale along with state-of-the art facilities for the synthesis and fabrication of devices along with core expertise in these areas are going to be crucial to break those fundamental barriers. The purpose of this workshop is to bring together experts from academics and industries in the area of UWBG materials for microelectronics and discuss the current challenges and opportunities in this field as well as to introduce the wealth of capabilities and expertise available at the Center for Nanoscale Materials (CNM) and other divisions at Argonne to the microelectronics community including academic and industrial users, and to make them aware of the various ways they can collaborate with CNM and Argonne staff scientists towards building a mutually beneficial partnership.

Microelectronics has already been identified as an emerging area of interest to DOE and there is a focus group established at Argonne to build collaboration with outside academic and industry collaborators to exchange ideas, foster collaborations with user facilities at Argonne to and embark upon new challenges in the areas of microelectronics

Workshop topics: The workshop topics will range from synthesis, characterization to fabrication and integration. The specific topics will include:

- Synthesis and characterization challenges in large area monocrystalline growth of diamond: This will include current state of the art in synthesis, doping and challenges
- Challenges and opportunities in utilizing diamond for active electronics: This will include progress utilizing single crystal and polycrystalline diamond for active electronics including diamond-based surface FETs for RF electronics to PIN diodes and other semiconductor devices for power electronics applications
- Diamond-based heterojunction devices: This will include active and passive integration of diamond with other semiconductor materials for enhancing electronic and thermal properties of the devices
- Diamond-based detectors and sensors for extreme environment: This will include current progress in the areas of developing advanced detectors and sensors in extreme environment.