

# ATOMICALLY THIN 2D MATERIALS-BASED FIELD EFFECT TRANSISTORS AND CHEMI-RESISTORS FOR CANCER SPECTROMETERS, CHIRAL QUANTUM DEVICE AND TOXIC ELEMENT MONITORING

Seminar

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### ABSTRACT

This talk introduces nano-fabrication of bio-chemical ligand modified 2D material-based wafer level and inkjet-printed bio-electronic solid state detectors with spatiotemporal control, enabling innovations in machine-intelligence-controlled cancer biopsy spectrometer, chiral/helical quantum technology, environmental toxin monitoring, and brain-machine interface based neurological device research. Inspired by nature's intricate designs, our hierarchical stacked geometrical configuration (HSGC) facilitates real-time volatile organic compound (VOC) cancer biomarker spectrograms and chiral molecule recognition. It enables machine learning-enabled liquid cancer biopsy for predicting breast cancer tumors and cancer organoid mutation status using a breakthrough time-space resolved Cancer Spectrometer (TITAN) combined with multi-omics fusion and advanced generative AI, eliminating complex biochemical procedures. Furthermore, spin-sensitive detectors constructed from chiral and DNA-like helical nano-hybrids of 2D materials offer exciting possibilities for identifying chiral molecules. This advancement could pave the way for a new era of organic chiral and helical quantum devices. Our technology enhances environmental hazards surveillance using ultrafast field-effect transistors (FETs) with graphene/black phosphorus 2D FET channels, detecting heavy metals (lead, mercury, arsenic), toxic ions (phosphates), and microorganisms (E. coli, Ebola virus) in aquatic samples. These devices also demonstrate applications in flexible feedback devices for soft matter robotics and brain-machine interfaces (BMIs) for neuro-diseases, such as Parkinson's, paralysis, and mute individuals, restoring speech and neuro ability. Our technology ensures sustainability through transient biodegradable electronics, minimizing device variation, promoting scalability, and advancing technology readiness levels (TRL). This presentation explores the transformative potential of 2D material-based nano- electronic devices for advancing our world utilizing various applications, such as, nano-electronics, novel room temperature quantum technology, organic spin device, medical and environmental monitoring device applications.



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PAMU SEMINAR ROOM



*Everyone is invited to attend*