An Overview of Capabilities and R&D at the Penn State Applied Research Laboratory's Electronic Materials and Devices Department (EMDD)

Electronic, Piezoelectric and Optical Materials Synthesis, Characterization, Device Fabrication and 3D Printed RF Electronics:

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EMDD is a vertically integrated laboratory with extensive capabilities for Research, Development, Prototyping, Reliability, Failure Analysis and Manufacturing Technology specializing in Electronic, Piezoelectric and Optical Materials and Devices.

Core capabilities include material synthesis with over 60 crystal growth systems capable of the growth of high quality bulk and thin films of SiC, Ga2O3, GaN, diamond, oxides, sulfates, graphene, hBN, cBN, 2D dichalcogenides, piezoelectrics and dielectric materials. Additional core capabilities include ceramics processing, materials characterization, electrical characterization, packaging, crystal/ceramic CNC fabrication, chemi-mechanical polishing, device/sensor design, nanofabrication and testing. EMDD also provides a wide range of S&T support for the three US Navy ManTech Centers of Excellence (Penn State ARL Electro-Optics Center (EOC), Penn State ARL Institute for Manufacturing and Sustainment (iMAST) and the Penn State ARL Electronics Manufacturing Center (EMC).

Three emerging research and development technologies at EMDD will be highlighted in this presentation. First, ongoing work in Ultra-Wide Bandgap (UWBG) semiconductors will be presented. Results will be shown from two AF ManTech programs on gallium oxide substrates, epitaxy and laterial FET devices. Recent research on large area mosaic diamond and cubic boron nitride synthesized with MPCVD will be described. Second, 3D printed electronics with integrated additive/subtractive and pick and place capabilities using an nScrypt multi-material printing system will be described. Applications in printed sensors, antennas, conformal/integrated electronics, flexible and stretchable electronics will be presented. The range of additional printing systems (e.g. Hyrel Hydra, Viscotec) for printing low resistivity signal and power traces will be described. Finally, 3D printed ceramics for RF, IR and Optical applications will be described with emphasis on high temperature capable materials for hypersonics.