S&T Campaign: Materials Research
Electronics
Energy Efficient

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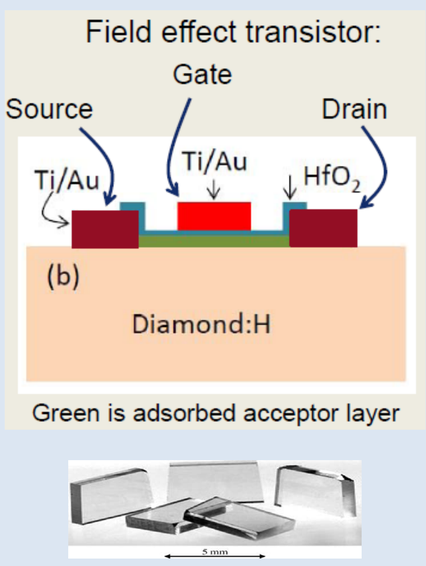
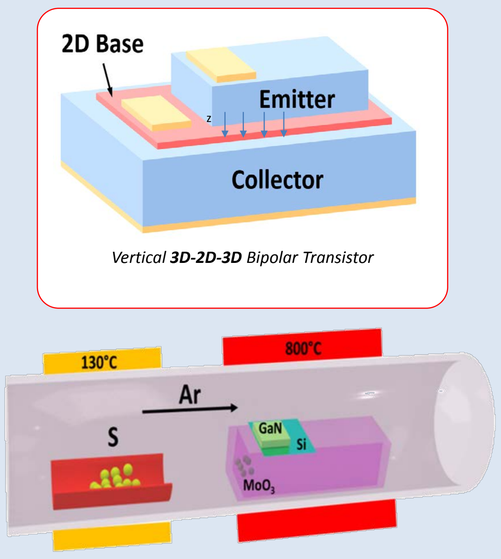
Research Objective

- **Provide substantial energy efficiency improvement in high-speed (RF) electronics to reduce power draw, increase mission duration, and reduce logistics tail**
- **Investigate devices that exploit emerging electronic materials such as 2D transition metal dichalcogenides and diamond-based devices**



Diamond RF Electronics

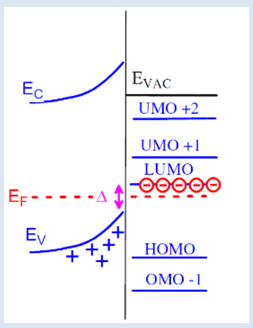


2D/3D Heterostructures

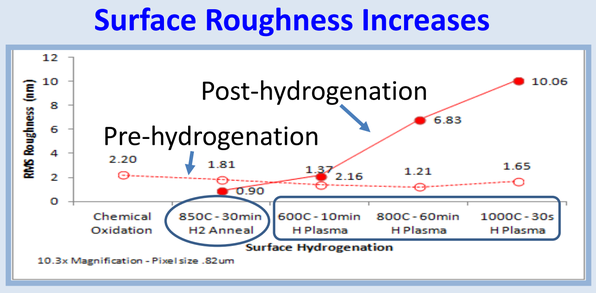
Challenges

- **Growing large-area single-crystal 2D materials; transport across 2D/3D interfaces**
- **Obtaining smooth, low-defect diamond surfaces**

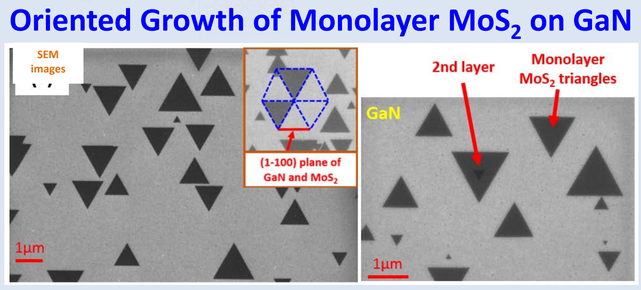
Transfer-Doped Diamond



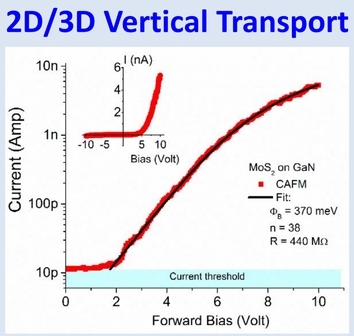
Surface Roughness Increases



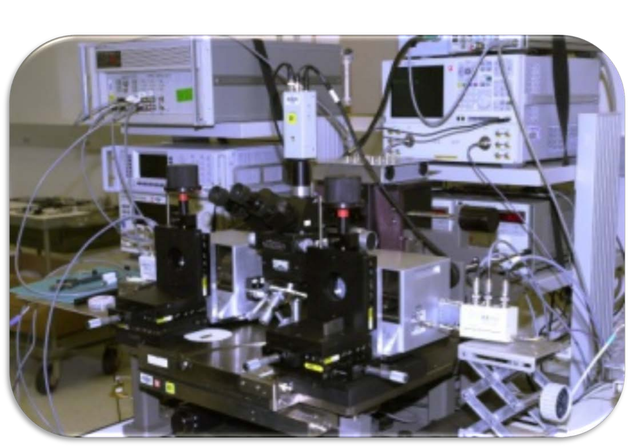
Oriented Growth of Monolayer MoS_2 on GaN



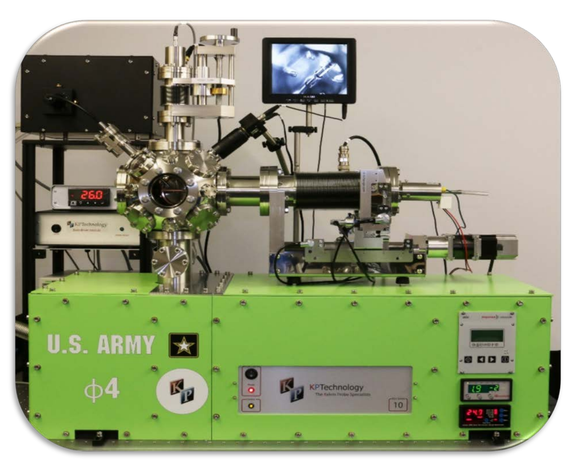
2D/3D Vertical Transport



ARL Facilities and Capabilities Available to Support Collaborative Research

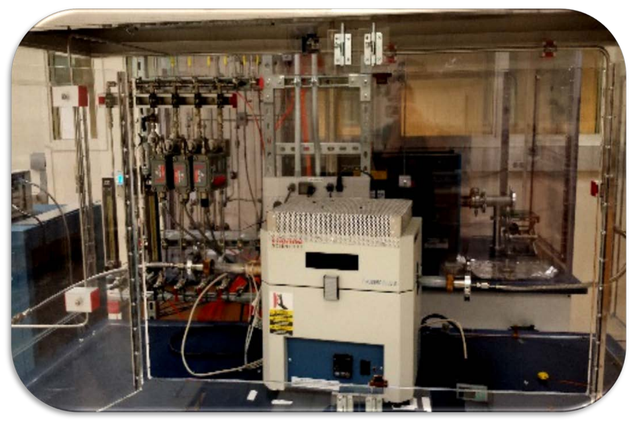


RF Characterization



Ultra-High Vacuum Kelvin Probe and Photoemission

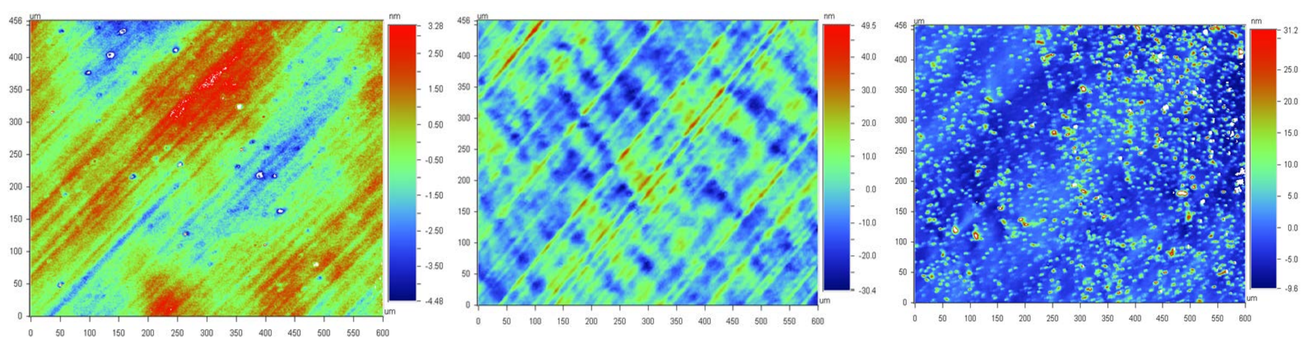
Combined Atomic Force Microscopy and Raman



2D Materials Chemical Vapor Deposition (CVD) Growth System

Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- **CVD growth of large-area electronic grade diamond**
- **Plasma hydrogenation of diamond surface**
- **Solid-state acceptor deposition on diamond**
- **Two-photon photoemission spectroscopy to map out band structure of 2D/3D heterostructures**
- **Low-energy electron microscopy (LEEM) measurements to identify orientation between MoS_2 and GaN**



600C – 10min ***800C – 60min*** ***1000C – 30sec***

Diamond Surface Roughness - Hydrogen Plasma