

DAGSI Research Topic Proposal

1. **Research Title:** *Synthesis of Large Area, Ultra-thin Boron Nitride for Next Generation Two Dimensional Nanoelectronic Systems*
2. **Individual Sponsor:**

Mr. Nicholas R. Glavin, AFRL/RXAS
3005 Hobson Way, Bld. 651, Rm 253
WPAFB, OH 45433
Nicholas.Glavin.1@us.af.mil
3. **Academic Area/Field and Education Level:** Materials Science and Engineering/
Nanoelectronic Materials; Ph.D. level
4. **Objectives:** Further develop existing synthesis techniques for ultra-thin boron nitride insulators towards larger area growth and the integration of these films into two-dimensional material heterostructure systems.
5. **Description:** Advances in applications of two-dimensional (2D) materials and their heterostructures is currently limited due to the absence of direct synthesis methods necessary to create reliable, large area device architectures. In particular, routes towards functional insulating materials for use as gate and substrate dielectrics, environmental protection layers, capacitors, and memory devices are of great interest. One such material that has been recently explored for these applications is ultra-thin boron nitride (BN) films. Recently, growth of BN materials by physical vapor deposition (PVD) has opened up the possibility to reproducibly synthesize amorphous and nanocrystalline boron nitride at reduced processing temperatures from conventional deposition procedures including chemical vapor deposition (CVD). In addition, the PVD technique can facilitate growth of 1-10 nm boron nitride films over relatively large areas ($>1 \text{ cm}^2$) with no evidence of cross-plane defects. In order to transition the technology to an electronics platform of interest to the Air Force, the uniform growth area must be expanded by several times to accommodate numerous electronic transistor configurations. Also, integration with other 2D materials including MoS₂, WS₂, and others into complex 2D heterostructures is of great interest to the DOD in next generation high speed and flexible device systems.
6. **Research Classification/Restrictions:** Not classified. Not restricted.
7. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided.
 - DAGSI (Wright State University, AFIT, Ohio State University, University of Dayton, Miami University, Ohio University, University of Cincinnati)
PA Approval #: 88ABW-2013-3021
 - AFIT (only)
 - USAFA (only)

If you are submitting a topic for the USAFA, please indicate if you are also interested in sponsoring a USAF Cadet in summer of 2015 (Avg Cost for USAF Cadet for 33 days was \$5000)

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Yes No