

- 1. Research Title:** Infrared Photonic Crystal Laser Development
- 2. Individual Sponsor:**  
Dr. Bradley Thompson  
AFRL/RVDHC  
2241 Avionics Circle  
WPAFB, OH 45433  
bradley.thompson.31@us.af.mil
- 3. Academic Area/Field and Education Level:**  
Electrical Engineering, Physics, Optics, Electro-Optics (MS or PhD level)
- 4. Objectives:** Research and advance the development of photonic crystal surface emitting lasers to improve brightness at infrared wavelengths in III/V semiconductors such as InP or GaSb through modeling, epitaxial growth, device fabrication, and/or characterization.
- 5. Description:** Photonic crystal surface emitting lasers (PCSELS) are a recent semiconductor laser development that harnesses a submicron patterned lattice to interact with a lasing mode and enables two-dimensional scaling of a single mode to millimeters or more. This photonic crystal creates a photonic bandgap and confines the optical mode without the need for additional mirrors. The surface emission of this large lasing mode results in a narrow divergence angle and high brightness beam. The majority of PCSEL development has been on GaAs based materials, but to reach longer infrared wavelengths other compound semiconductor systems are necessary such as InP or GaSb. Applications for infrared high brightness and compact laser source include communications, sensing, and LiDAR. Research is necessary to develop PCSELS at infrared wavelengths of interest and explore the limitations. Submissions should focus on the specific areas of interest for the student such as device modeling and simulation, epitaxial development, semiconductor processing and metrology, and/or device characterization. AFRL has in-house facilities and expertise to support this work with commercial photonic physics solvers, cleanroom fabrication facilities, and infrared laser characterization equipment.
- 6. Research Classification/Restrictions:** Unclassified/U.S. Citizenship required.
- 7. Eligible Research Institutions:** All

Distribution Statement A: Approved for public release. Distribution is unlimited.  
PA approval number: AFRL-2024-4587