

1. Research Title: Engineering Nonlinear Optical Materials

2. Individual Sponsor:

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3. Academic Area/Field and Education Level

Physics, Materials Science, or Applied
Optics(MS or PhD level)

4. Objectives: Develop and engineer structured nonlinear optical materials by employing resonant and effective media approaches in composite systems. The aim is to conduct comprehensive effort including: 1) growth using a physical vapor deposition process, 2) characterization with surface analysis techniques, and 3) quantification of optical response with optical characterization techniques such as second harmonic generation (SHG) for potential use in infrared detection.

5. Description: Nanolaminates, or materials deposited sequentially having thicknesses on the order of tens of nanometers, will be generated in-house using physical vapor deposition techniques. These films are each individually centrosymmetric materials and superlattice structures will be designed in such a manner as to realize a second-order nonlinear optical response by breaking inversion symmetry, resulting in nonlinear effects such as second harmonic generation (SHG). In Situ ellipsometry is used in conjunction with pulsed laser deposition (PLD) and magnetron sputtering (MS) for precision growth of the nanolaminates, SEM/TEM/XPS/EDS will be used for materials thin film characterization, and optical characterization can be accomplished using nonlinear optical characterization techniques including spectral second harmonic generation. This technology is important because it can for example provide for the ability to detect IR signals through up conversion, i.e., a standard 1550 nm IR communication signal could be detected with a 775 nm detector, and in addition we will explore applications in wavelength conversion for quantum information systems.

6. **Research Classification/Restrictions:** No classification requirements other than to have a standard public clearance approval for presentations and publications.

7. **Eligible Research Institutions:** No exclusions on research institutions.