

1. **Research Title:** Investigation of the optical properties of novel 2D materials
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Materials Science and Engineering, Crystal Growth, Advanced Optical Characterization, (BA/BS, MS or PhD level)
4. **Objectives:** The objective of this research is to characterize the non-linear optical properties and responses of metal-thiophosphates/selenophosphates, through the use of femtosecond pump-probe experimentation, z-scan techniques, and laser damage experiments, in order to build our understanding of this vast phase space of novel 2D materials.
5. **Description:** Metal thio/selenophosphates represent a unique realm of 2D layered materials, in that the chemistry, and therefore properties and structure, are highly variable, with practically only two major limitations being: the charge balance of the  $(P_2S/Se_6)^{4-}$  sublattice, and the metal ions fitting geometrically within that sublattice. With broadly variable compositions, and properties, understanding the optical characteristics and trends of this system could help guide device design and help to identify compositions of particular interest, while damage testing of these materials may open avenues of unique femtosecond pulsed laser modification/processing techniques in 2D materials. Compositions of particular note include  $CuInP_2S_6$ ,  $CuScP_2S_6$ ,  $AgScP_2S_6$ , and  $CuCrP_2S_6$ , but this is not an exhaustive list given many of these compositions are grossly understudied. The proposed work will consist of growing bulk samples of metal-thio/selenophosphate crystals through vapor transport or flux growth methods, verifying composition and structure through XRD and SEM-EDS, performing femtosecond transient absorption pump-probe experimentation, z-scan testing, and femtosecond damage studies to understand the full suite of optical behaviors. The compounds of interest that will be studied, should be looked at in both bulk and after exfoliation. Raman spectroscopy may be used as well to explore the structures of these materials should the material show promising structural variability.
6. **Research Classification/Restrictions:** These materials are all 6.1 research and are thus not restricted with respect to classification.
7. **Eligible Research Institutions:** The Ohio State University