

**Synthesis of BaXP<sub>2</sub>S<sub>6</sub> and BaX<sub>2</sub>P<sub>2</sub>S<sub>8</sub> nonlinear optical material crystals (X = Zn, Cd)**

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Middle infrared and ultraviolet lasers have significant civilian life and military applications, and researchers have been interested in finding the best way to create them. Through the synthesis of middle infrared nonlinear optical materials (MIR NLO), middle infrared lasers can be created via the nonlinear harmonic process. However, much of the challenge is to discover NLOs that exhibit all seven of their ideal aspects: non-centrosymmetric crystal structure; suitable band gap; large second-harmonic generating (SHG) coefficients; high laser damage threshold; moderate birefringence; excellent thermal, chemical, and air stability; and ability to be grown in large amounts of single crystals. In this study, BaZnP<sub>2</sub>S<sub>6</sub>, BaZn<sub>2</sub>P<sub>2</sub>S<sub>8</sub>, BaCdP<sub>2</sub>S<sub>6</sub>, and BaCd<sub>2</sub>P<sub>2</sub>S<sub>8</sub> were the target compounds based on the Ba<sub>2</sub>P<sub>2</sub>S<sub>6</sub> parent compound, as [P<sub>2</sub>S<sub>6</sub>] motifs have been previously shown to exhibit large SHG coefficients. Additionally, this study was conducted based on the Jahn-Teller theory and the notion that the disordered arrangement of Zn<sup>2+</sup> and Cd<sup>2+</sup> would contribute to the novel NLOs would not only exhibit but enhance the ideal properties of NLO crystal synthesis. Samples were based on stoichiometric calculations, made within a glovebox, sealed using a vacuum and torch, and put into a furnace. X-ray diffraction was conducted for two of the samples for analysis (graphs of Intensity vs. 2-Theta were produced) and the experimental peaks matched data of known metal thiophosphates in published research. Therefore, the target compounds were not achieved because mixed metal cations were not involved in the system. Future approaches to synthesizing crystals based on the Ba<sub>2</sub>P<sub>2</sub>S<sub>6</sub> parent compound are discussed.