# Hybrid Germanium Bromine Perovskites with Tunable Second Harmonic Generation

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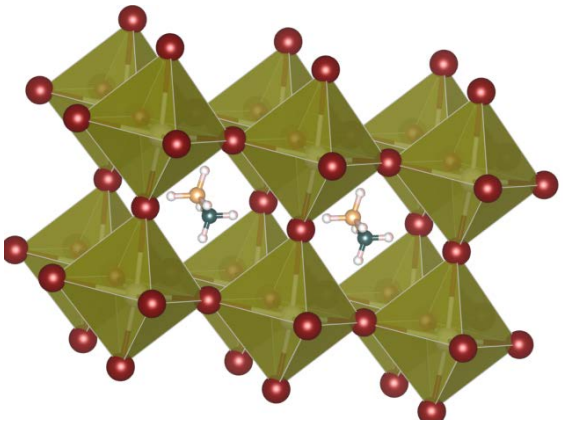

*Figure 1: Crystal structure of the Methylammonium Germanium Bromide hybrid 3D perovskite. The $[GeBr_6]^{4-}$ units, form the corner − sharin octahedra.*

Over the last decade, researchers have been particularly concerned with hybrid organic-inorganic halide perovskites, owing to their remarkable materials' chemistry and physics. Due to their exceptional semiconductor characteristics and charge-transport ability, they are one-of-a-kind optoelectronic materials. They've also been used to create photovoltaic devices with up to a 25% efficiency in power conversion.[1] Germanium-based perovskites, in particular, have attracted immense interest due to their ability to crystallized into non-centrosymmetric space groups,[2] which in turn enables the expression of strong nonlinear optical (NLO) properties. Second Harmonic Generation (SHG), in particular, is strongly amplified, corroborated by the presence of soft, highly polarizable atoms in addition to the necessary pre-requirement of the absence of a crystallographic inversion symmetry. SHG is a property that is of paramount importance for the laser industry providing the ability to manipulate the wavelength of coherent monochromatic light.

In this work we present a series of new series of germanium-based bromide perovskites which crystallize in polar space groups and exhibit strong SHG responses relative to the commercially used compound potassium dihydrogen phosphate (KDP). The compounds possess a direct optical bandgap between 2.4-3.1 eV, possessing a relatively narrow SHG-transparent region to the Nd:YAG laser source (1064nm). Nevertheless, the particle size dependence of the SHG response suggests that all the materials possess a phase matchable behavior and are still promising candidates for use in their transparent SHG region. Ongoing work on the wavelength-dependent performance suggests that the efficiency of the SHG response can be strongly enhanced at longer excitation wavelengths.

References

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