Third-Order Harmonic Generation in Bulk Topological and Non-Topological Crystals

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Solid-state harmonic generation (HG) offers insights into sub-femtosecond phenomena within condensed matter systems. We select a series of crystals with different electronic band-structure features to work toward elucidating the effect of topological surface states on third-order harmonic generation (THG). We compare $Al2O_3$, a direct band-gap material, and $Fe2O_3$, an indirect band-gap material, and in the future will add $Cr:Al2O_3$, a direct band-gap material, and $Bi2Se_3$, a topological insulator. We use a 20-TW Ti:Sapphire laser ($?centra_l$ =800nm, 25 fs, 10 Hz) inside a vacuum chamber at 10^{-6} Torr, in the reflection geometry with the sample at $45r^c$ relative to the incident beam. The THG signal was detected by either a UV CCD camera or spectrometer which was in the atmosphere. We first studied the THG dependence on laser polarization and then on driving laser intensity, from ~0.2 TW/cm^2 to ~1.2 TW/cm^2. The THG dependence on laser polarization was studied and no such dependence was observed. We have experimentally compared the THG energy in $Al2O_3$and$Fe2O_3$ through laser intensity scans on these materials and observed differences in generated THG energy between both materials.

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