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NONLINEAR OPTICS OF FERROELECTRICS MATERIALS

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ABSTRACT

Due to the existence of spontaneous polarization below transition temperature T_C , ferroelectrics materials like $BaTiO_3$ have been known to possess very high linear electric susceptibility. It is expected that these materials also have very high nonlinear susceptibility coefficients for second- and third-order nonlinear processes like second-harmonic generation (SHG) and third-harmonic generation (THG). In principle, they would be able to produce SHG signal for example and have the potential to be used as a frequency doubler at terahertz frequency range.

Here, we explore these possibilities. Based on the Landau-Devonshire theory and the Landau-Khalatnikov dynamical equation, we formalize a theory to calculate all the linear and nonlinear electric susceptibility coefficients for bulk ferroelectrics materials by assuming that they have tetragonal symmetry at temperature below T_C. Based on experimentally obtained parameter values for $BaTiO_3$ we estimate the magnitude of one of the nonlinear susceptibility coefficients for SHG. Finally, using the theory of nonlinear wave propagation we estimate the amount of SHG signal that can be transmitted from a ferroelectric Fabry-Perot resonator.

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