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Application of Second Harmonic Generation on Ferroelectrics

With the invention of Light Amplification by Stimulated Emission of Radiation (laser) light with a very high intensity became available. Only with these extraordinary high intensities, with typical fields in the order of magnitude of 108 V/m, nonlinear optical effects are observable. The very first nonlinear effect that was demonstrated is the second harmonic generation (SHG) in 1961. This effect, which is also referred to as frequency doubling, causes the generation of a single photon from two incident photons. The resulting photon will possess twice the energy and frequency and consequently half the wavelength of a single incident photons. This presentation will deal with the fundamental physics of this effect and will furthermore outline its practical application in materials science. The main focus lies on the utilization of SHG techniques with respect to ferroelectric materials: SHG not only allows for imaging of domains but also the detection of noncentro-symmetry which is a necessary structural condition for the occurrence of ferroelectricity. Therefore SHG provides a suitable way to measure phase transformations from the polar ferroelectric into paraelectric phase.