Struct Chem Crystallogr Commun, 3:2
DOI: 10.21767/2470-9905-C1-003

Optically active phonons in titanyl crystals and their effects on the operation of nonlinear optical laser sources

Oleksandr Isaienko
IPG Photonics, USA

Birefringent optical crystals have enabled operation of nonlinear optical laser sources since the 1960's. The effectiveness and robustness of various nonlinear optical (NLO) processes in these crystals, such as second harmonic generation (SHG), sum-frequency generation (SFG), and optical parametric amplification (OPA), relies on the lack of interaction between the laser beams and the resonant modes in the NLO crystals. In this way, the NLO polarization driven in the birefringent NLO-active crystals is only driven by the instantaneous oscillations of electrons. In this work, we report on a different type of light-matter interaction in NLO laser sources in which the optically-active phonon modes present in certain NLO crystals of titanyl family (e.g. KTiOPO4, KTiOAsO4) couple to the interacting laser beams. These interactions lead to the effects such as wavelength shifts in the output beams. These effects are explained by the impulsive excitation optically active phonons in these crystals which effectively leads to ultrafast modulation of the crystal's optical nonlinearity. We will discuss the general principles behind the application of birefringent crystals in NLO laser sources, and introduce the effects of intrinsic resonances, such as lattice phonons present in certain NLO materials, on the operation of NLO devices. We also discuss the implications of these photon-phonon interactions in the terahertz (THz) wave generation.

oleksandr.isaienko@gmail.com