

IR-induced laser operated PbTe:Ca crystals

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Abstract IR induced piezo-optic effect (POE) in PbTe:Ca crystals were found under the influence of pulsed nanosecond CO₂ laser with a wavelength of 10.6 μm . It was demonstrated that addition of Ca leads to an increase of the POE tensor coefficient values. This indicates the appearance of enhanced IR induced static ground state dipole moments caused mainly by Ca dopant. At the same time the POE time kinetics was studied. A substantial contribution of electron–phonon interaction to the observed POE effect was found. The measurements were done both for diagonal as well as off-diagonal POE tensor components.

Keywords Optoelectronic crystals · IR laser lead chalcogenide crystals · Optical materials · Piezo-optics

1 Introduction

Lead telluride (PbTe) single crystals belong to semiconducting group described by general formula $A^{\text{IV}}B^{\text{VI}}$. Their physical and chemical properties are isomorphous with cubic sodium chloride-type lattice (Fano 1995). Generally, PbTe is a nonstoichiometric crystal. As a consequence it should possess n- or p-type conductivity (Liu et al. 2013; Jiang et al. 2013; Delaire et al. 2011; Christakudi et al. 1995). PbTe crystals are also promising for high-ZT thermoelectric devices due to their narrow band gaps (about 0.31 eV at ambient temperatures), face-centered cubic structure and large average value of exciton Bohr radius (~ 46 nm) providing strong quantum confinement effects within a large range of size. Particlarly, it may present the cationic substitution of Pb by Ca due to the partial non-compensation of the valence states.

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