NONLINEAR OPTICAL CHARACTERIZATION OF KDP CRYSTAL DOPED WITH TiO_2 NANOCRYSTALS

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Ferroelectrics with hydrogen bonds, due to relatively high nonlinear efficiency and dielectric permittivity, huge piezoelectric effect and pyroelectric properties, the possibility of the spontaneous polarization reorientation in a relatively small field are successfully implemented in a wide class of optoelectronic devices and sensor technology, nonlinear optical and information optical storage, etc.

The incorporation of organic dyes molecules or nanoparticles subsystems in the crystal lattice of the KDP type nonlinear optical (NLO) materials is the promising approach to the controlled efficiency enhancement of their NLO response.

For the first time the method of temperature lowering was used to grow KDP single crystals from aqueous solutions containing TiO_2 (anatase) nanocrystals. The concentration of TiO_2 in the initial solution varied from 10^{-3} to 10^{-5} M/l. Preliminary study was found that the crystal can easily capture the TiO_2 nanoparticles with subsequent formation of semicoherent boundary between the KDP layer-by-layer growth that provides 2D ordered distribution of the anatase nanoparticles in the crystal [1]. It was measured the crystal lattice parameters increase that can indicate about the bonding force changes in the crystal lattice of the KDP:TiO_2. The effect of the giant NLO response of the TiO_2 nanoparticles in the KDP matrix was observed. Its manifestation level essentially depends on the matrix crystallographic structure. It was shown a possibility to control the cubic giant nonlinear optical response [2] of the incorporated metal oxide nanocrystals in the matrix with picosecond range laser pulses. It can be realized due to the resonance excitation of the intrinsic defects and anatase nanoparticles subsystems with competitive nature of their contributions. Thus it is possible to realize the following schemes of light-by-light control: (i) efficiency of the frequency conversion within the phase-matching conditions variation due to the photoinduced phase shifts; (ii) phase modulation (chirp) control along the pulse; (iii) enhancement of the quadric NLO response within the cubic one.

References

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