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Session:
GROWTH OF QUANTUM DOTS, WIRES, AND NANOCRYSTALS

Title:

Synthesis and characterization of KTiOPO_4 nano- and microcrystals prepared by modified Pechini method

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Abstract:

Potassium Titanyl Phosphate (KTiOPO_4 or KTP) is an excellent non-linear crystal (NLO) and the most commonly used material for frequency doubling of Nd:YAG lasers and in optical parametric oscillator (OPO). It exhibits high nonlinear optical coefficient, very high optical damages threshold, broad transparent range, relatively high effective second harmonic generation coefficient (SGH), wide acceptance angle and thermally stable phase-matching properties. The properties of KTP make it superior as an electrooptic modulator as well as an optical waveguide device, including phase modulators, amplitude modulators and directional couplers.

The Pechini method has been used as an alternative to the conventional sol-gel to obtain nanocrystals materials for different applications because of low cost, versatility, control of the stoichiometry, its simplicity, low processing temperature high degree of homogeneity due to the reagents are mixed at the molecular level. First, the chelates are formed between metals ions and an α -hydroxycarboxylic acid (citric acid, CA). Later, a polyhydroxyl alcohol (ethylene glycol, EG) is added and heated to obtain a polymeric resin formed of randomly where the cations are uniformly distributed. Heating of the polymeric resin at 573 K causes a breakdown of the polymer. The following step is the calcination of breakdown polymer at known temperature for several hours to obtain the nanocrystalline material.

In this study the modified Pechini method was used, where ethylenediaminetetracetic acid (EDTA) replaces CA due to its strong chelating power. EDTA has four carboxylic acid groups (CA has three) and can react with EG to form a more branched polyester resulting in a more homogeneous sol.

The modified Pechini method was used to obtain orthorhombic KTP nanocrystals with space group $Pna2_1$. The thermal analysis was used to study the thermal evolution of the breakdown polymer. The studies of X-Ray powder diffraction indicated that the nanocrystals began to crystallize at 873K. The morphology and the size particle were determined by electronic microscopy. The powder technique of Kurtz has been used to analyse the SHG efficiency of the material.

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