Study on lattice dynamics of sol-gel derived $Pb_{1-x}La_xTiO_3$ thin films and optical properties of Er-doped $Pb_{0.8}La_{0.2}TiO_3$ thin films

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Abstract

This work makes a study of the lattice dynamics of $Pb_{1-x}La_xTiO_3$ thin films by Raman spectroscopy, and the luminescence mechanism of erbium-doped $Pb_{0.8}La_{0.2}TiO_3$ films. All samples were prepared by sol-gel method. In the $Pb_{1-x}La_xTiO_3$ (PLT) system, we found that considering Ti-disorder induced background is necessary during the analysis of Raman spectra. The giant splitting of longitudinal optical (LO) and transverse optical (TO) phonon modes has been found while x increased from 0.00 upward 0.20. The decreasing LO-TO splitting, which is the same with $Pb_{1-x}La_xTiO_3$ (PST) system, was observed in $Pb_{1-x}La_xTiO_3$ (PLT) system. The change of effective charge to the LO-TO splitting is the dominant mechanism in PLT. In addition, the dependence of green luminescence efficiency on Er^{+3} concentration and sintering temperature in the Er-doped $Pb_{0.8}La_{0.2}TiO_3$ thin films is governed by crystallinity and ion-ion interaction. Our study indicates that the observed green emission reaches maximum at 3 mol % Er dopant concentration with the best crystallinity.