

## DOCTORAL THESIS

### Dielectric properties and defects structure of lead tungstate crystal

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**Dielectric Properties and Defects Structure of  
Lead Tungstate Crystal**

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A thesis submitted in partial fulfillment of the requirements  
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Doctor of Philosophy

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## Abstract

A detailed investigation has been carried out into the defects structure of lead tungstate,  $\text{PbWO}_4$ , in the pristine state, annealed in oxygen, or doped with La, Y or Sb. A number of important conclusions have been reached. The experimental evidence has come from the dielectric spectra, UV-visible transmittance spectra, Thermoluminescence, dc resistivity, XPS, TG and DSC measurements.

In as-grown PWO, after UV-irradiation, dielectric relaxation peaks were observed, at room temperature in the kHz region. It is deduced that color centers are formed within the  $\text{WO}_4^{2-}$  tetrahedra of the lattice. Such peaks were absent in an appropriately annealed crystal, indicating its enhanced radiation hardness. Relaxation processes also occur in La- and Y- doped samples, at higher temperatures when the measurement frequencies lied also in the kHz region. Evidence from impedance spectroscopy and other measurements confirm that the introduced  $\text{La}^{3+}$  ions almost exclusively occupy the  $\text{Pb}^{2+}$  lattice sites, while  $\text{Y}^{3+}$  are partly substitutional and interstitial. Both kinds rare-earths doped material, if excessively annealed in oxygen, exhibited a second dielectric relaxation and showed decreased transmittance near 420 nm. PWO containing Sb gave relaxation peaks at sub-ambient temperature.  $\text{Sb}^{5+}$  ions are thought to take up interstitial position, until their concentration exceeds  $\sim 60$  ppm, when some  $\text{Sb}_w^{5+}$  also exist. A systematic trend in defects structure is apparent from La to Y to Sb, and primarily determined by the charge states and ionic radii of the dopants.

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