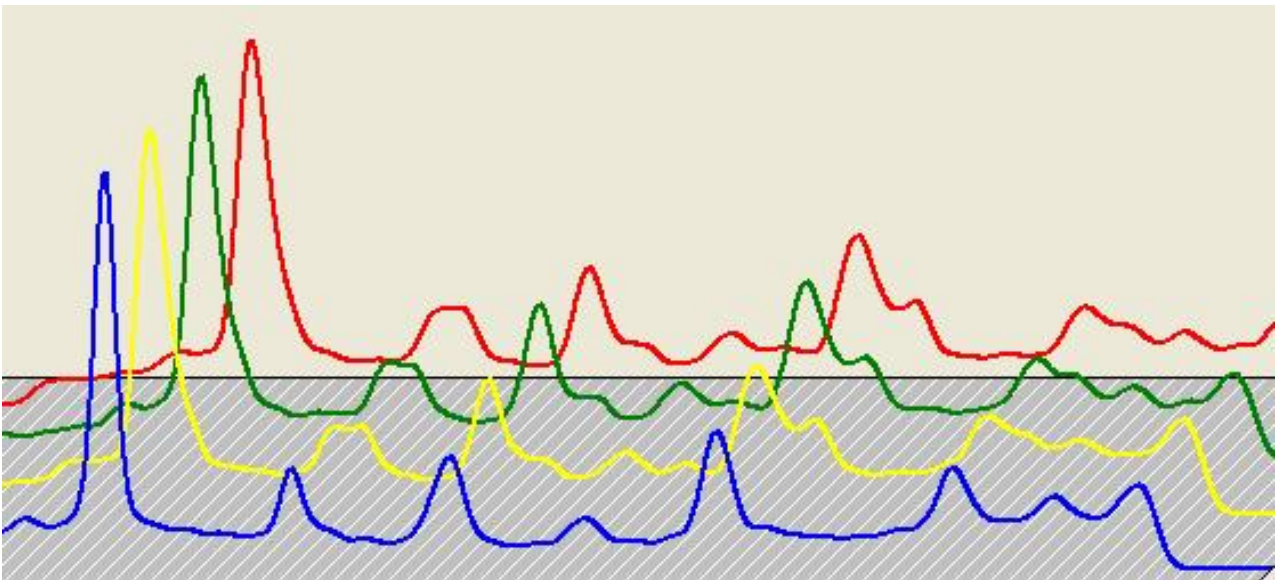


# Inspection Check of Production of Complex Compounds (ferropiezoelectrics, ferrites)

*The work was done by joint efforts of the Institute for Roentgen Optics and ELPA LLC, Zelenograd*

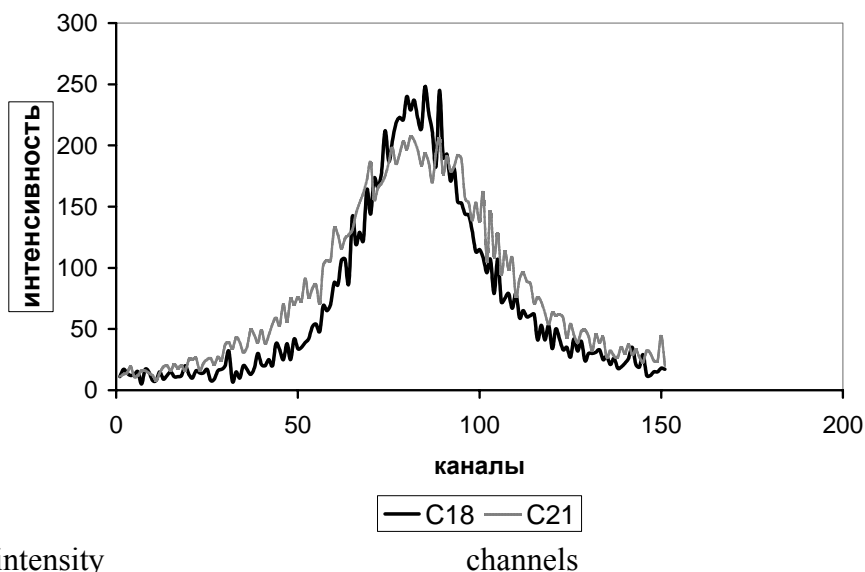
**The method of inspection control of production of compounds with known beforehand properties and complex structure was elaborated based on the example of manufacture of CTS ferroelectric items. The object of investigation was  $\text{PbTi}_x\text{Zr}_{1-x}\text{O}_3$  system. Ferroelectrics of this type feature maximum piezoelectric properties only in the range close to the border of tetragonal –rhombohedral morphotropic transition ( $x \approx 1.48 \pm 0.02$ ). This interval is correspondent to pseudo-cubic lattice with crystalline cell of  $a=b \approx c$ .**

1. Synthesis completion for powders with pre-determined structure was analyzed. The figure show the powders' diffractograms after synthesis.



Samples were synthesized at 930°C (3 hrs) in chamber furnace simultaneously. The figure shows experimental diffractograms of syntheses characterizing different level of completion of the CTS phase synthesis reaction as a result of temperature gradient inside the furnace.

2. As technological parameter, FWHH (B) was suggested for the strongest line of diffractogram (110). Tetragonal splitting in this line is not observed but line widening does occur.

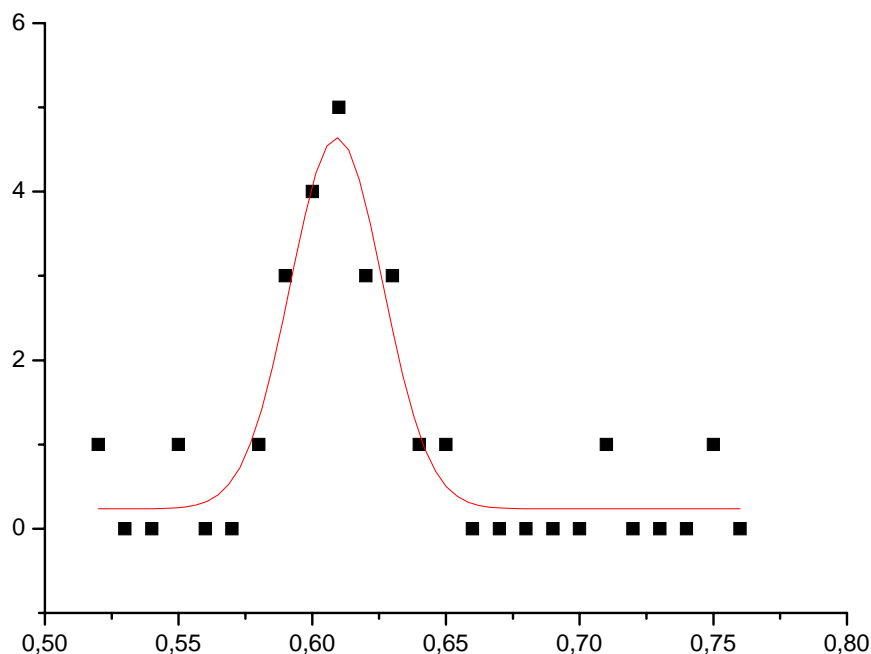


intensity

channels

A fragment of diffractograms of synthesized CTS19 powders for two syntheses with different synthesis completion level (for C18  $B(110)=0.52$ , while for C21  $B(110)=0.75$ ).

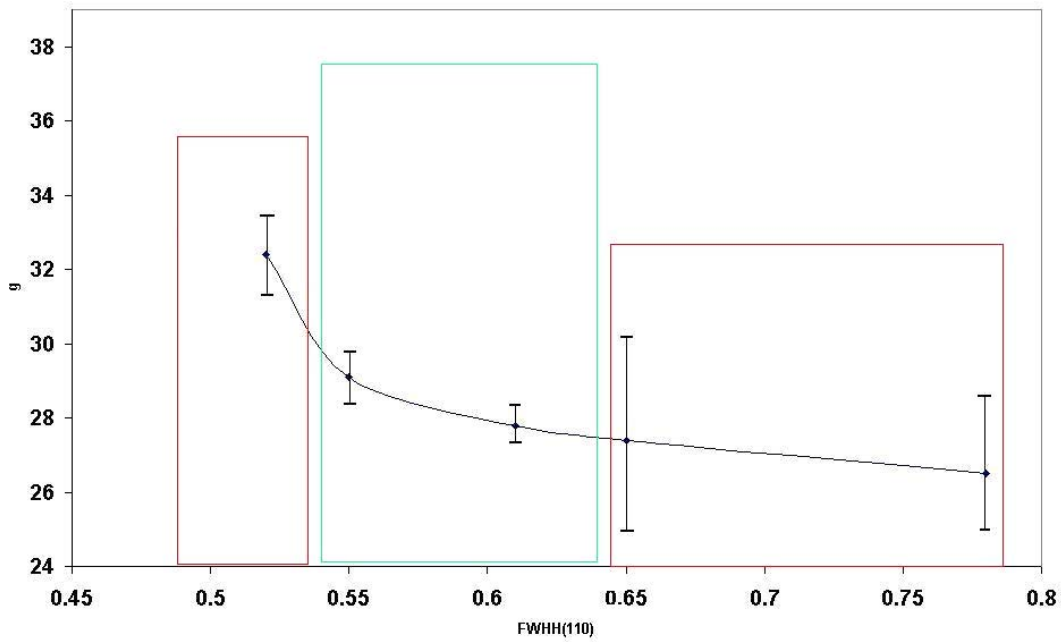
Over 60 samples were analyzed, and statistic analysis of distribution of technological parameter B was undertaken.



Statistic distribution of syntheses as regards the diffraction reflection width (110)  $B_{tot}$ . Statistic processing of experimental values of  $B_{tot}$  {110} has shown that they follow the Gauss distribution, dispersion being 0.03 and maximum position being  $B_{max}$  {110}=0.61. The interval of  $B=0.57\div 0.65$  describes 99.5% of CTS-19 produced.

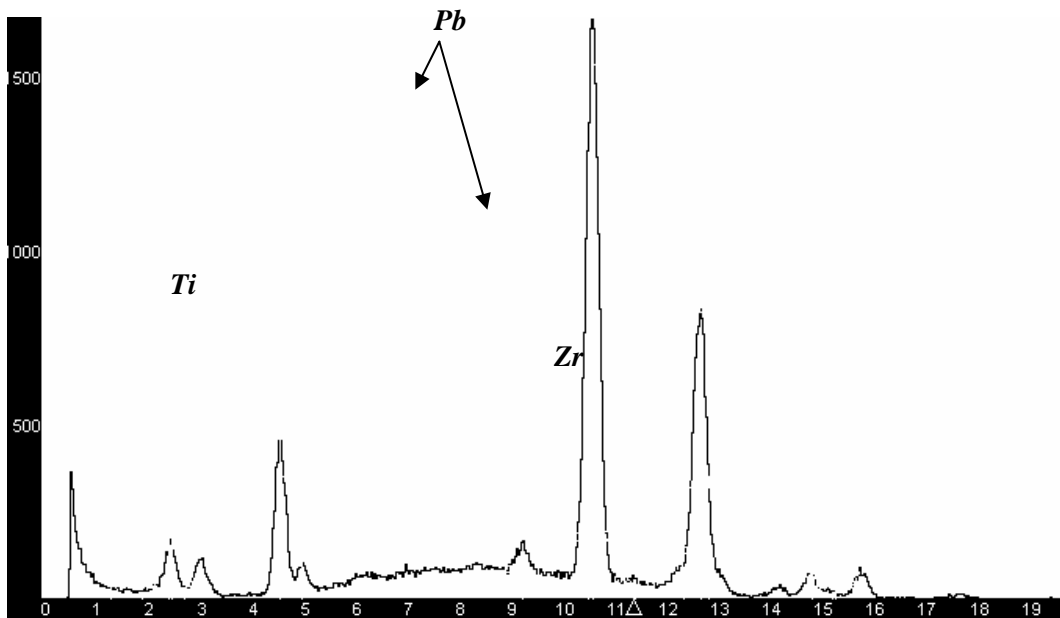
This statistic distribution was compared to the finished products' fitness data.

The region of admissible values of B was determined.

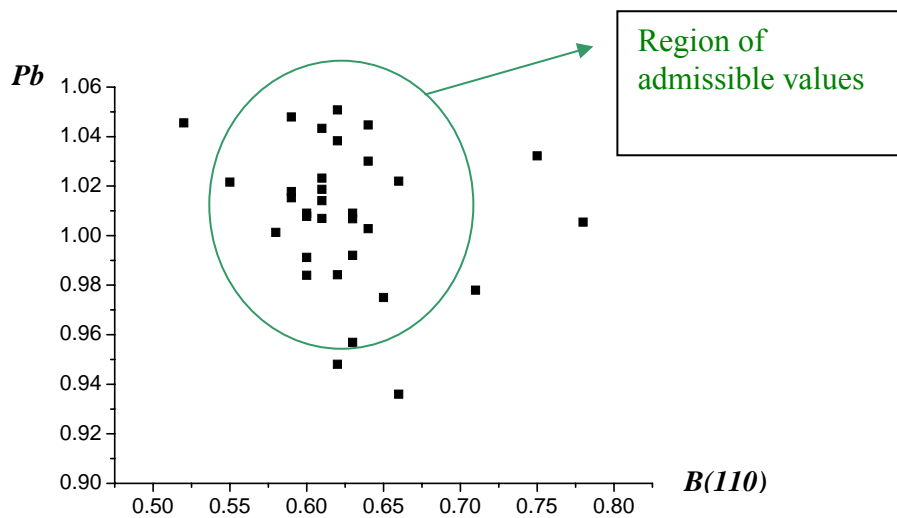


The region of admissible values of B(110) and the risk region are determined in the course of production by admissible technological losses for particular manufactured products.

3. Based on x-ray fluorescent analysis, Pb content in synthesized powders was checked.

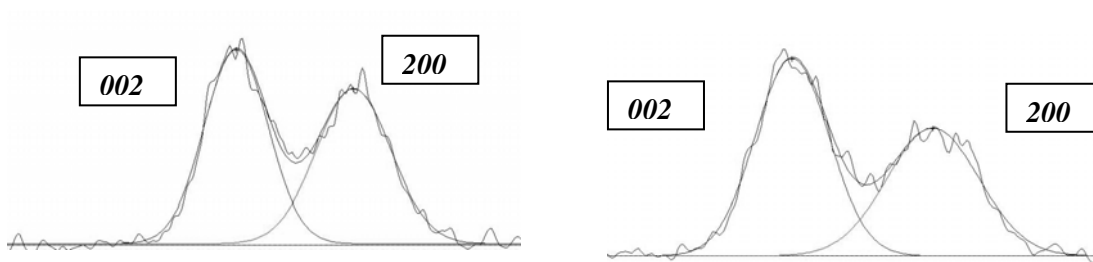


CTS-19 energy dispersion spectrum. Positions of the basic spectrum lines are marked. Based on Pb line intensity, statistic analysis of lead content in samples was performed.



Correlation of relative Pb line intensity from RFA spectrum and B(110) half-width for syntheses.

#### 4. Feature analysis of finished polarized samples.



The figure shows fragments of diffractograms in the range of reflections {200} for piezo elements featuring different level of polarization. In the course of products' polarization, domains ordering takes place towards [100], which affects the correlation of intensities of peaks (200) and (002).

1. Ibraimov N.S.,Likhoushina E.V., Dolgaya Zh.A.,Golovnin V.A.. IRO, ELMA Moscow.Russia, 22 European Crystallographic Meeting/ Budapest/2004/Thesis, p228
2. Ibraimov N.S.,Likhoushina E.V., Dolgaya Zh.A.,Golovnin V.A. Piezoceramics. 2006 (in Russian).