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MULTICHANNEL MEASURING SYSTEM OF PLANAR DEPENDENCIES OF PYROELECTRIC CURRENT

Multichannel measuring system of planar dependencies of pyroelectric current is presented.

Описано багатоканальну вимірювальну систему для визначення планарних залежностей піроелектричного струму.

Introduction

Experiments, upon character of the phase transition in non linear ferroelectrics, belonging to TGS group, conducted by many authors [1-5], proved significant dependence between electric parameters of the sample and place of sample cutting. Different temperature characteristics of pyroelectric coefficient, spontaneous polarization, and electric permeability were observed for the samples cut of different single crystal regions. In some cases slight shift of the Tc temperature was observed. It is caused by the fact that electric parameters are strongly related with growth pyramids present in the sample. It was quite obvious that the next step in our researches should be related with measurements of planar dependence of electric parameters.

In order to perform this task we designed and constructed computer measuring system, making possible parallel recording of pyroelectric current from 6 regions of the sample's surface. This paper contains information about idea of measuring system and first measurements performed with use of one channel.

Experiment

Measuring system will consist of PC computer with AD/DA data acquisition card and 6 channel measuring current amplifiers. Diagram of one current amplifier is shown on fig. 1.

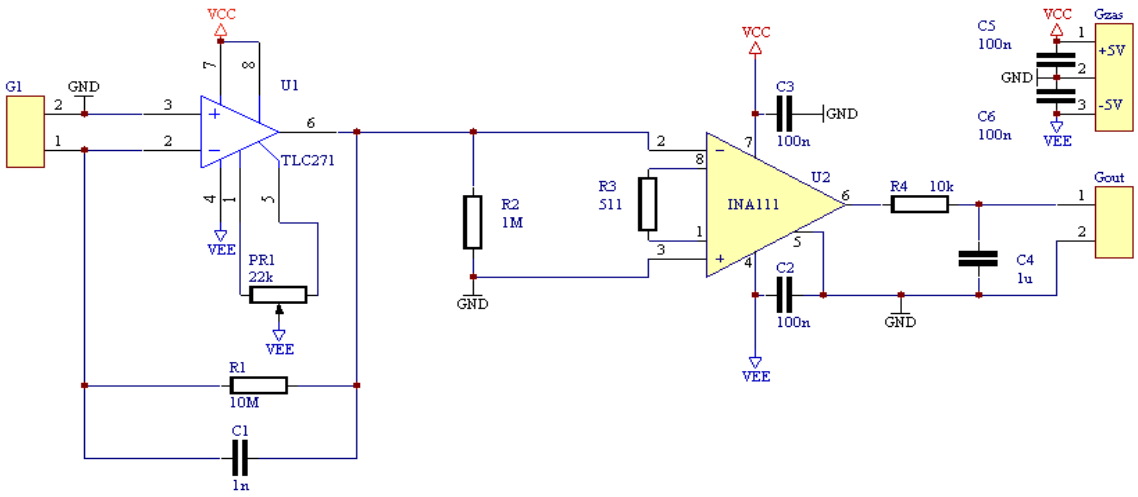

Fig. 1 Diagram of current amplifier (one channel).

Key parameters of utilized devices

- INA111 is measuring amplifier with calibrated gain (wide range of regulation with use of 1 resistor). Unbalanced voltage for this device is 500uVmax.

- TLC271 is low noise operation amplifier with very high input impedance – typically $10^{12}\Omega$ and extremely low current of input polarization – typically 0,7pA (max 60pA). Unbalanced voltage for this device is typically 1,1mV, but it can be adjusted by external resistor.

Block diagram of measuring system is presented on fig. 2.

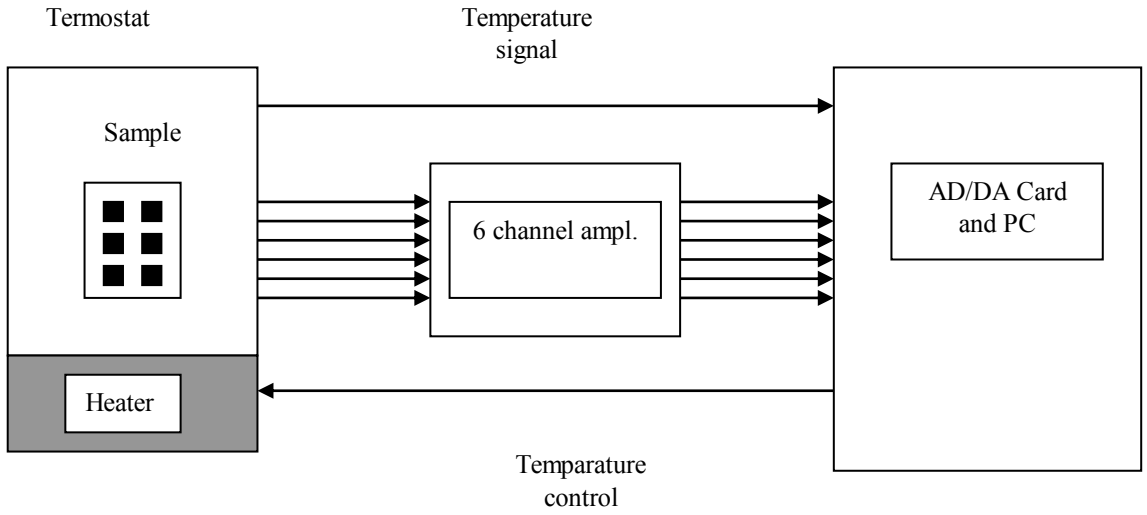

Fig. 2. Block diagram of measuring system.

Preparation of the samples

As researched material was used triglycine sulphate (TGS) in the single crystal form. [6-8]

TGS is obtained in reaction of sulfuric and amino-acetic acids. Chemical formula of TGS is: $(NH_2CH_2COOH)3 \cdot H_2SO_4$. Solution of TGS is obtained by mixing proper amounts of distilled water and mentioned above acids. Such obtained solution is filtered and left for crystallization. Crystals are dissolved in distilled water and left for successive crystallization, in order to eliminate impurities. In the moment when spontaneous crystallization occurs, at the bottom of the crystallization vessel, small single crystals are taken off and treated as the seeds for the regular crystal growth. Seeds are mounted on the end of the rotative handle, plunged in the solution. Handle is rotating with speed 60 rev./min. Evaporation speed is adjusted experimentally.

Single crystals are cut into 2mm slices, with use of wire saw, perpendicular to the ferroelectric b axis. After mechanical treatment samples are formed in a shape of rectangular parallelepiped, measuring 6mm x 6mm x 2mm. Electrodes are attached to the sample's surface as it is shown in fig 3.

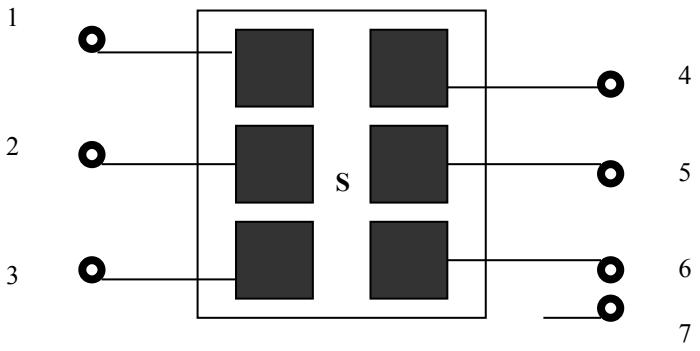

Fig. 3. Ferroelectric sample and attached electrodes (top view). S-sample, 1-6 top electrode contacts, 7-GND.

Control measurements and conclusions

Control measurements were performed with use of one channel of new designed system. Measurements were repeated several times and compared with measurements made with use of high accuracy KEITHLEY K195 picoammeter. Comparison of the characteristics let us expect that after assambling and configuration of remaining channels we will possess new and unique tool for measurements of planar – temperature characteristics of pyroelectric effect. Comparison of processing characteristics is shown on fig. 4. Temperature characteristic of pyroelectric current measured with use of new designed system is presented on fig 5.

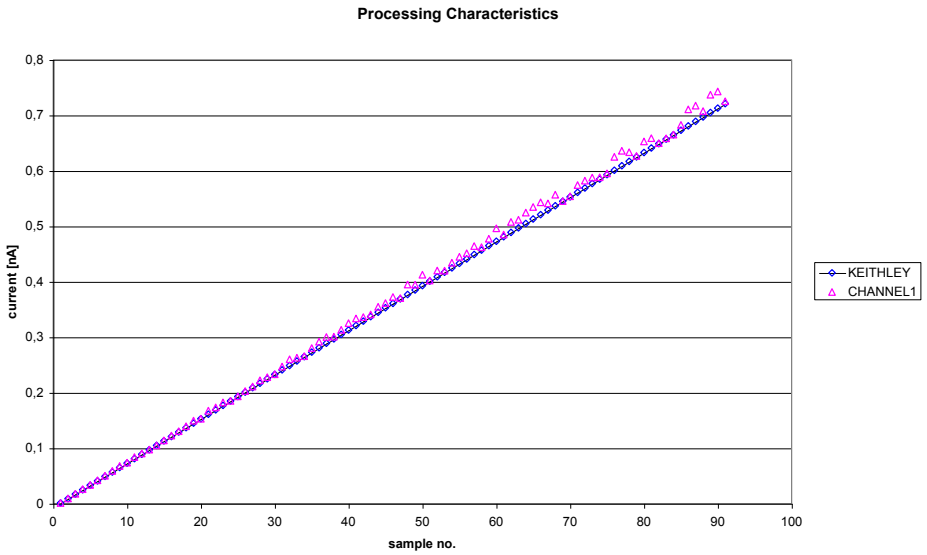

Fig. 4. Comparison of processing characteristics

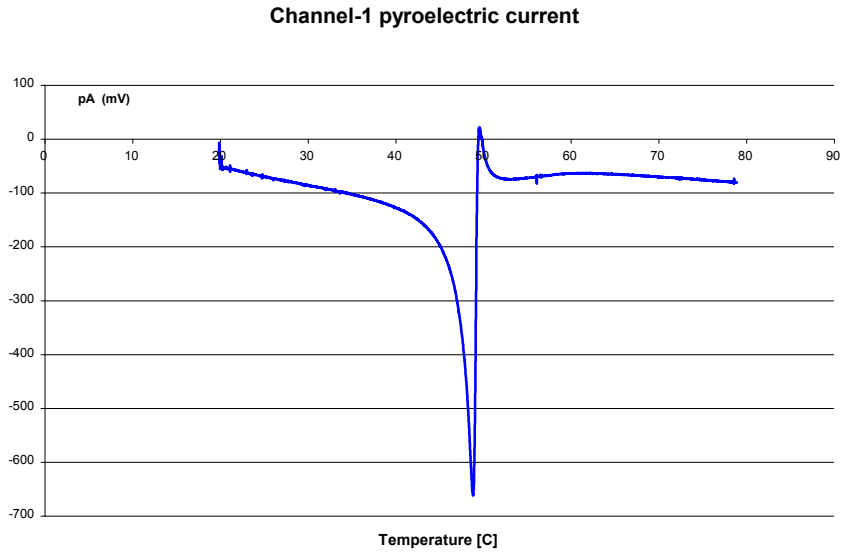

Fig. 5. Temperature characteristics of pyroelectric current recorded with use of new designed system.

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