Materials of Conferences

EXPERIMENTAL RESULTS OF ELECTRIC ACTIVITY OF «ELECTRONIC - IONIC CONDUCTION» JUNCTION

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The "electronic-ionic conduction" junction is formed in chloride-silver electrodes, which have got application in various instrument making areas: medical – to take off human superficial biopotentials; geophysical – to measure constant electric fields of the earth; analytical tool engineering – as comparison electrodes. The main variables of the electrodes are as follows: electrolytic potential drifting on DC current; natural noise of the electrodes in various frequency diapasons; electrode impedance; polarization voltage. The electrical parameters of the junction depend on the technology of its production, and also the quality of the materials used.

With the measuring device resolution enhancement the threshold value declines and the minimal measured quantity decreases. Therefore, severe demands on the electrical parameters of electronic components, integrated circuits are placed and new technologies of their production are created or the current ones are perfected.

The transducers should also be perfected, as their noises are summarized additively together with measuring facilities' natural noise and lower the thresholds of measuring devices. Measuring of noise electric activity of the "electronic-ionic conduction" junction is a topical problem, as the existing devices can only measure the summarized junction noises and measuring facilities' ones, which exceed the junction noises significantly.

We have developed a plant to check up the chloride-silver electrodes – a computer-equipped PCE-2, wherein the junction natural noises can be estimated with the average nanovolt order value with the accuracy of not less than ±10% with the help of specially developed informational-measuring technology, the plant having passed the tests successfully in the RF Committee for Standardization, Metrology and Certification.

It allows comparing the junctions made with the help of various technologies for the purpose of their quality evaluation.

As a comparison there were made three electrode cells representing the system "electrode-electrolyte-electrode": "EC_1" – a pair of single-service chloride-silver electrodes of Italian production made according to the traditional technology of plating a sensing layer of Ag-AgCl on the basecoat; "EC_2" – a pair of chloride-silver electrodes made on the basis of porous ceramics of Tomsk Polytechnic University production, Russia; "EC_3" – a pair of nanoelectrodes made using modern nanotechnologies; Tomsk Polytechnic University production, Russia.

From the carried out experimental studies the following has been obtained:

- The minimal drifting on the DC current, which made 0,001 mcV/sec and is an order less than the EC_1 and EC_2 drifting, the EC_3 nanoelectrodes have, the electrodes of Italian production having the maximal drifting.
- The amplitude excursion of electrode cells' natural noises in various frequency diapasons is equal to:

- (0,01-1)Hz – EC_1- ±50nV; EC_2- ±6nV; EC_3 - ±5nV;
- (0,05-75)Hz – EC_1- ±300nV; EC_2- ±60nV; EC_3 - ±35nV;
- (1-500)Hz – EC_1- ±420nV; EC_2- ±120nV; EC_3- ±80nV;

- The electrode impedance average value at different currents and frequencies - I=0,1 mcA; 1 mcA; 10mcA; frequencies – 0,01 Hz; 0,05Hz; 0,15Hz; 1Hz; 2Hz; 75Hz; 10000 Hz – is equal to – the EC_1 resistance makes 1500 O; the EC_2 resistance makes 800 O; the EC_3 resistance makes 300 O.
- The polarization voltage depending on the flowing DC current value - 0,1mcA; 0,5 mcA; 1 mcA; 2 mcA; 3 mcA; 5 mcA; 10 mcA is equal to – the EC_1 polarization voltage changes from (– 1,5 mV) to (-31,18 mV); the EC_2 one - from (-2,5mV) to (-12,88 mV); the EC_3 polarization voltage changes from (-0,24 mV) to (-8mV). At the current change up to 0,5 mcA the electrode cell EC_3 made on the basis of nanotechnologies is not polarized.

As it is seen from the above material, the junction created on the basis of nanotechnologies has the highest characteristics from the obtained results. Nanoelectrodes have the least electrode potential drifting, natural noise level, impedance and practically are not polarized under the DC current influence.

Therefore, nanoelectrodes are the most promising for wide application in various instrument making areas: medical, geophysical and analytical.

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