

3. Potrč T. et al. (2015) Electrospun polycaprolactone nanofibers as a potential oromucosal delivery system for poorly water-soluble drugs //European Journal of Pharmaceutical Sciences. vol. 75. pp. 101-113

## STRUCTURE OF SALT SOLUTION IN POLAR DIELECTRIC LIQUIDS AND ELECTRICALLY-INDUCED SEPARATION OF SOLVATED IONS

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The aim of the study is to demonstrate that separation of solvated ions in mixed salt solution under the action of the external periodic electric field occurs because of around ions, the clusters having dimensions of  $\sim 0.1 \mu\text{m}$  and consisting of the solvent molecules are formed.

In investigation the cluster dimensions were defined theoretically, and the value of frequency of the external electric field, which action excites the effect of the solvated ions separation, was determined experimentally [1-3]. The experiments were conducted at the Technical Physics Department of the National Research Tomsk Polytechnic University.

When determining the dimensions of clusters, Poisson's equation was solved, and it was considered that solvent polar molecules were oriented under the action of electric field of an ion. The chemical composition of the solution sample was determined using the X-ray excited fluorescent radiation analysis method.

Theoretical estimates and experimental results confirmed the assumption, that clusters formed around ions in the solutions, have the dimensions of  $\sim 0.1 \mu\text{m}$ .

At determination of the electric field amplitude-frequency parameters, by means of which it is possible to excite an ion-selective mass transfer in solution, we needed correct estimation of the sizes of covers formed from solvent molecules around ions. Thus, the traditional description of solvated ion properties based on the Debye-Huckel approach, led us to the fact that the ion-selective mass transfer in solution had to take place at the frequencies of external electric field of  $\sim 10 \text{ MHz}$ . Nevertheless, really ion-selective mass transfer in solution was excited at frequencies of  $\sim 100 \text{ Hz}$ .

The results of the research have shown that placing of volume distributed electric charge of ion in dielectric liquid is accompanied by the formation of the supramolecular particles called "clusters", the linear dimensions of which are significantly more than the first and the second radiuses of solvation ( $\sim 1 \text{ Angstrom}$ ), and reach a size up to  $\sim 0.1 \mu\text{m}$ . At such dimensions, the inertial properties of clusters and their natural frequencies give the chance to operate their movement by means of action of the external electric field on the solution.

The conducted theoretical estimation has revealed the possibility of associates (clusters) formation from solvated ions in salt solutions in dielectric liquids. It is probable that the action of external periodic electric field with different intensity amplitudes in half-periods causes the directed motion of not separate solvated ions, but associates-clusters formed by the solvated ion groups. Significantly larger mass of the associate and, consequently, a bigger value of the inertia moment can explain the manifestation range shift of electrically- induced drifting effect of solvated ions towards smaller frequencies at salt concentrations to  $10 \text{ g/l}$  that comply with the experimental results.

### REFERENCES

1. Shamanin I.V., Kazaryan M.A. (2014). Clusters Formation in Salts Solution in Polar Dielectric Liquids and Electrically-induced Separation of Solvated Ions. British Journal of Applied Science & Technology 4(18): pp.2538-2550.
2. Shamanin I.V., Kazaryan M.A. (2012). The Use of Electrical Induced Selective Drift of Solvated Ions in Solutions Phenomena in Technologies. International Journal of Research in Physical Chemistry. Vol. 2. № 4. pp. 40-44..

3. Kazaryan MA, Lomov I.V, Shamanin I.V. (2011). Electro-physics of structured solutions of salts in liquid polar dielectrics. Moscow: Fizmatlit.

## **ELECTROPHYSIOLOGICAL METHODS TO ASSESS PSYCHO-EMOTIONAL STATE OF A PERSON BASED ON MEDICAL NANOSENSORS**

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Psycho-emotional state is a special form of a human psychical state with the dominance of emotional responses. Emotional displays are essential to response to real-life situations, because they regulate health and functional state of the body [1]. Electrophysiological methods enable to investigate electrophysiological parameters reflecting psycho-emotional state of a person. Electrocardiography (ECG), electromyography (EMG), electroencephalography (EEG), electrooculography (EOG), and galvanic skin response (GSR) are basic methods that allow recording muscles stimulation, palpitation, the blood outflow from the skin surface, brain activity, etc.

ECG is a method for recording potential differences in the heart's electric field occurring during the heart activity. The averaging of all vectors of action potential occurring at a certain moment of the heart's activity influences the ECG results. The deflections from the normal ECG shape can be found in one or more leads, and this greatly helps to diagnose the heart failure.

EEG is a method focused on brain research using the recording of the electrical potential differences arising during the brain activity. EEG characterizes some states of a person (calmness, stress, excitement) because different brain parts respond to different emotional state [2].

GSR is a sensitive indicator of emotional state. It is determined by the changes in the bioelectric parameters of the hand skin (potential differences and impedance). GSR is caused by vibrations of pre-secretory sweat gland activity controlled by the central nervous system. The factors of emotional and mental activity primarily influence GSR.

EMG is a method of bioelectric potentials research arising in skeletal muscles in the excitation of muscle fibers, recording the electrical activity of muscular. EMG recording allows revealing the intention to start movement a few seconds before the movement. Moreover, myogram serves as an indicator of muscular tension.

EOG is a graphical recording of potential differences arising from changes in the eye movements. The anterior pole of a human eyeball is electrically positive, and the back one is negative, therefore, there is a potential difference between the bottom and cornea of the eye, which can be measured.

The improvement of resolution means that to assess psycho-emotional state of a person is currently very important. The Institute of Nondestructive Testing, Tomsk Polytechnic University, is going to develop medical nanosensors to pick-up biopotentials with higher stability of electric potential, stable contact and polarization potentials, and lower interference and impedance. The existing methods of psycho-emotional state assessment combining subjective and objective testing methods are to be used in examining patients.

### **REFERENCES**

1. Bezrukih M. M. Psychophysiology.( 2006). Dictionary. M. M. Bezrukih, D. A. Phaber. Psychological lexicon. Encyclopedic dictionary. Moscow: PER SE. p 128.
2. Rusinova V. S. (1987). Brain biopotentials of a person. Mathematical analysis. V. S. Rusinova. – Moscow: Medicine. p.256.