New Solid Inorganic and Polymer Electrolytes. Non-Contact Methods of Investigation of their Conductivity.

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The report is a continuation and development of the authors' works aimed at the development of the elaboration of all-solid phase lithium high energy power sources. The presented results are related to the problem of solid electrolyte production with a high ionic conductivity in lithium ions. Usually, the measurement of the specific ionic conductivity of solid electrolytes at alternating current is seriously complicated by the influence of a contact resistance between solid electrodes, to which alternating current is supplied, and a surface layer of solid electrolyte.

In the work, to exclude this preventing factor the following special non-contact methods used for the determination of solid electrolyte conductivity have been substantiated, developed, investigated and tested:

- condensation method by using alternating current in the wide frequency range of alternating current up to 35 MHz
- eddy current method in the frequency range up to 280 MHz.

Conductivities for the two types of solid electrolytes were investigated:

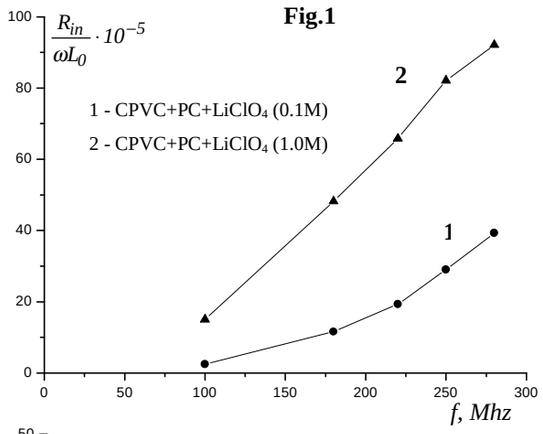
- based on inorganic systems with amorphous structure similar to glass one.
- based on polymer non-aqueous organic systems.

Solid inorganic electrolytes were synthesized by using oxide mixtures. Such electrolytes were investigated as homogeneous pore-free thin films (from 4μm) and as heterogeneous samples pressed from the powders of initial material. The homogeneous films were deposited on a substrate by using the specially developed methods [1,2].

The films of polymer organic solid electrolytes comprised the initial polymer base (chlorinated polyvinyl chloride [3,4] or PVDF), lithium salt and aprotic plasticizer.

In the paper the criteria of applying the developed non-contact methods of conductivity measurement by using the theory of eddy currents method have been substantiated. The mathematical model of sensor work for the case of the final thickness of solid electrolyte has been described. Influence of the composition of solid electrolytes on ion conductivity has been studied. The mechanism of ion conductivity in synthesized solid electrolytes has been suggested. Testing results of the actual samples of lithium secondary batteries using solid electrolytes of the optimized composition have been presented.

The developed methods can be successfully used while solid electrolytes investigated and optimized as well as under the production control of power sources aimed at providing their high quality.



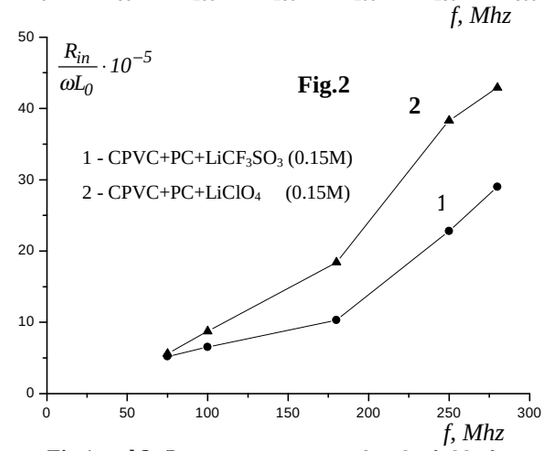


Fig.1 and 2: R_{in} - resistance inserted in the field of inductance coil by the investigated object, f - device frequency, L_0 - intrinsic induction of the coil of electromagnetic field source.

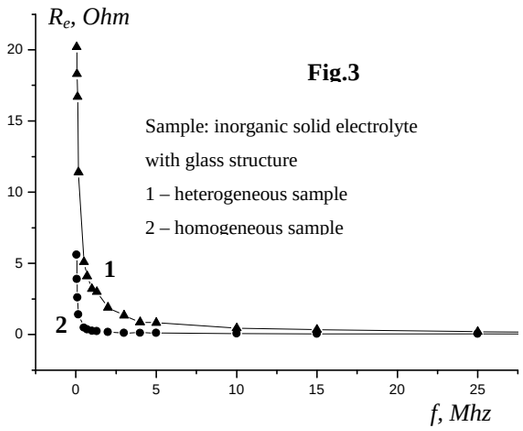


Fig.3: R_e - Equivalent resistance of the system converter-sample, measured by a capacitance non-contact method

Acknowledgments

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