PROPERTIES OF $NaClO_4$ PMMA BASED GEL ELECTROLYTES

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Introduction

Batteries and accumulators are main sources of energy for mobile devices at present. The electrolytes are very important components of accumulators. Liquid electrolytes have some disadvantages. There is the possibility of effusion, dress or hands stain and necessity of the work in selected location.

New polymer and gel electrolytes are searching, because they can the liquid electrolyte substitutes. They are meaning specific benefits for lithium cells and some others applications electrochemical devices with hermetic and anhydrous systems.

Experimental

These gel electrolytes are prepared chemically. This method is based on mixing electrolyte with material of polymerization. For this purpose, we used material called Superacryl. This is compound of two ingredients, liquid monomer and powder oligomer, which starts to polymerize. We used the solution of alkali metal salts and an organic liquid (propylencarbonate – PC 99.7 %) and in next step we added mixture monomer and oligomer. In this way we get the electrolyte simply without application or any heat or light. Amount powdered oligomer in mixture is controlling time of solidification.

The ratio for superacryl gel samples was used as follows:

1 ml liquid electrolyte + 1.5 ml MMA + 700 mg superacryl powder

For applications of polymer gel electrolytes it is necessary to know his electrical parameters, for instance the specific conductivity. These samples were monitored depending on temperature within the range from 223 K up to 360 K. Cycling was performed in this temperature range. All measuring was done using the device HP 4192A LF IMPEDANCE ANALYZER 5 Hz -13 MHz with measuring fervencies 1 kHz, 4 kHz, 10 kHz, 40 kHz a 1 MHz.

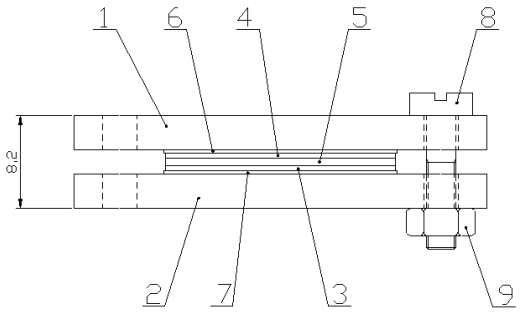

Fig. 1 *Design of measuring cell for polymer gel.*

Components of measuring cell:

1. electrode no.1 fixation system
2. electrode no.2 fixation system
3. measuring electrode no.1
4. measuring electrode no.2
5. sample of polymer electrolytes gel
6. isolation of measuring electrode no.1
7. isolation of measuring electrode no.2
8. male screw M3
9. female screw ČSN M3

Results and discussion

The differences dependences are very small for all three cycles of measuring and specific conductivity is falling with decrease of temperature.

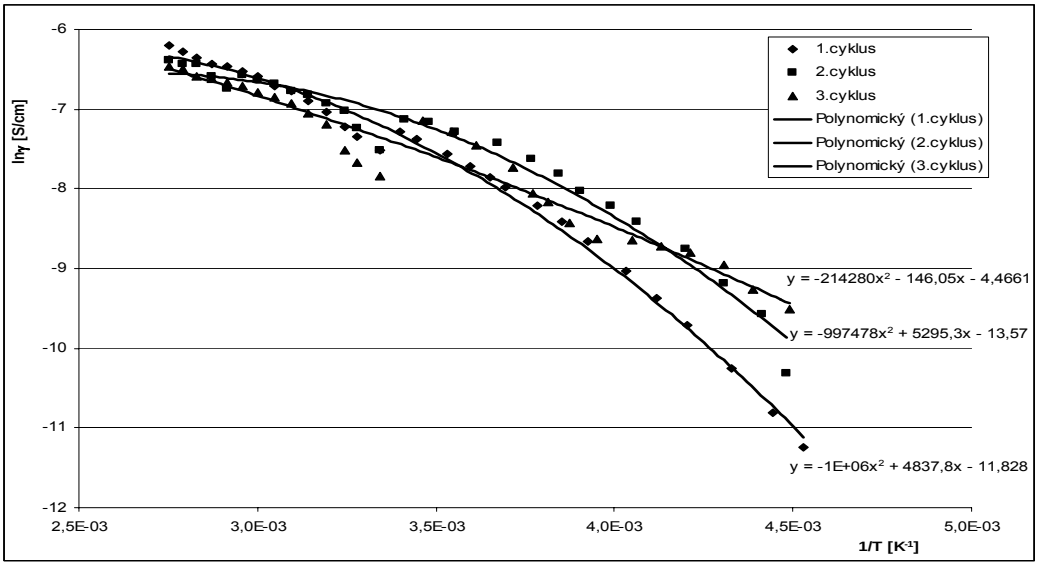

Fig. 2 *Specific conductivity of $NaClO_4$ gel with concentration 1M (99.7 %PC). Measuring frequency 10 kHz.*

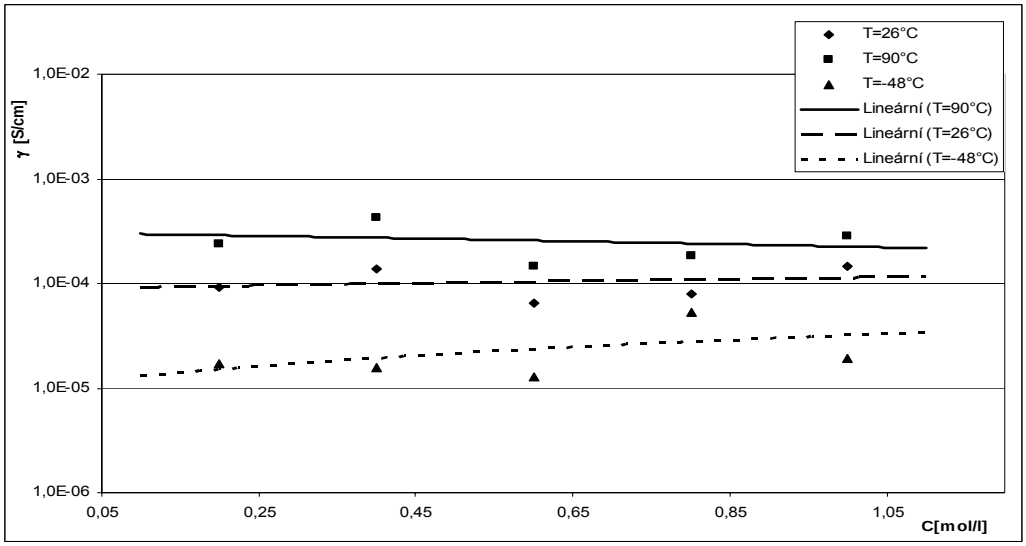

Fig. 3 *Specific conductivity of $NaClO_4$ gel (99.7 %PC) dependence up concentration. Measuring frequency 1 kHz.*

The dependencies of this measuring are nearly same for all days of measuring.

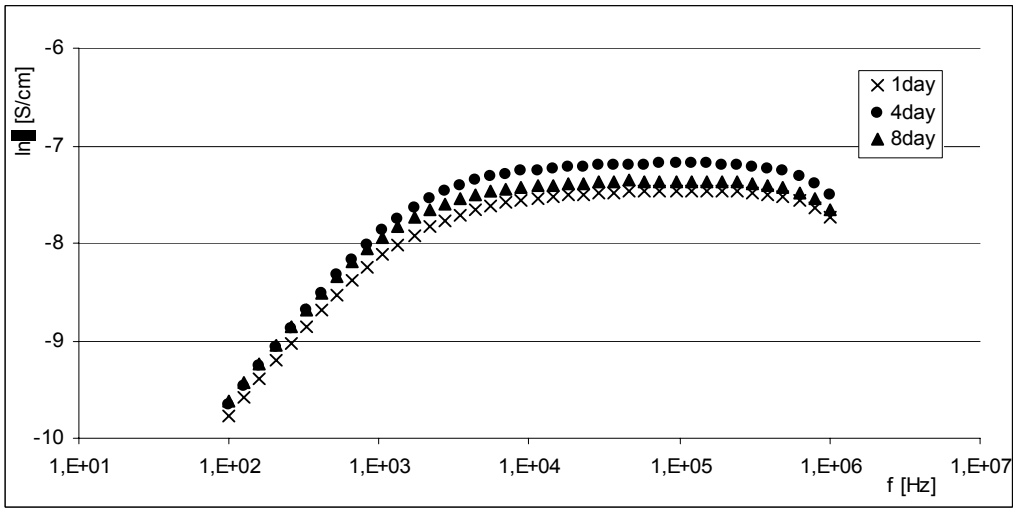

Fig. 4 *Specific conductivity of $NaClO_4$ gel (99.7 %PC, 1M) dependence up measuring frequencies and time.*

Conclusions

The theoretic possibility of the aprotic electrolytic gel properties and their reversibility for temperature up -50 °C to 90 °C has been verified during our research. These properties of these materials implicate for integration into files of the materials that are to be used in modern electrotechnic devices and technologies.

The first measuring with nuclear magnetic resonance is creating today. This research will be continuing with another salts and electrolytes.

Acknowledgements

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References

1. J. Vondrák, Interkalační pochody v elektrochemických zdrojích proudu, VUT Brno 2001.
2. T. Nováček, Vodivost gelových elektrolytů obsahujících vybrané soli, Technický projekt VUT Brno 2004.
3. A. Kalašová, A. Toušková, Chémia a fyzikálna chémia pre elektrotechnikov.
4. T. Nováček, Gelové elektrolyty, Technický projekt VUT Brno 2001.