GEL POLYMER ELECTROLYTES

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Gel polymer electrolytes belong to the most progressive components in the technology of lithium batteries, electrochromic windows, and some other devices. Their physical properties are rather advantageous from viewpoints of technology and application.

Systematic investigation of polymer electrolytes based on polymerization of methyl methacrylate with the addition of aprotic electrolyte solutions has been performed. The electrical conductivity of gels containing smaller cations is lower than that of gels with larger ions of the same valence. Therefore, we investigated this phenomenon more extensively.

As the polymer, technical methyl methacrylate “Dentacryl” was used. To the monomer, the solution of perchlorate in propylene carbonate (PC) was added. The monomer was used either as-received (containing stabilizing agents), either pure. Then, the polymerization was started by the addition of the oligomer. The polymerization is more accelerated if more oligomer had been added. The resulting conductivity is within $10^{-4}$ to $10^{-3}$ [S/cm] at room temperature.

In general, the electrolyte was prepared from the solutions of Cd(ClO$_4$)$_2$, Mg(ClO$_4$)$_2$, Zn(ClO$_4$)$_2$ and/or LiClO$_4$. Three mixtures were prepared from 4 ml of monomer, 1 ml of stock solution of Cd(ClO$_4$)$_2$ 1 ml of Mg(ClO$_4$)$_2$, Zn(ClO$_4$)$_2$ and/or LiClO$_4$, respectively, and 2 g of oligomer. This way, 50% of cadmium was replaced by the other cations.

The conductivity of the gel was recorded during 8 days using an RCLG bridge at frequencies 400, 1000, 40000, 10 000, and 20 000 Hz. The series equivalent circuit was used for the measurement.

The samples prepared from monomer “as-received” were of violet colour at the beginning and their colour turned to light brown in the course of time. They were transparent.

The highest conductivity was observed for the gel containing Zn perchlorate, the least conductivity in the case of LiClO$_4$ containing gel. The results are shown in Fig. 1.

The addition of polystyrene caused considerable lowering of conductivity. Also the conductivity of gels, which contained stabilizers, was fairly low. On contrary, the non-woven cloth did not worsen the electric properties at all (see Fig. 2).

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Fig. 1: The conductivity of gels at room temperature.

Further, the polymerization was modified by various additives. The result is shown in following Fig. 2.

Fig. 2: The influence on temperature on the conductivity. Materials from top to down: non-stabilized MMA, stabilized MMA, polystyrene dissolved in PC, and non-woven cloth PE.