A Study on Electrochemical Characteristics of DPEPA-Based Gel Polymer Electrolyte

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Introduction

Lithium ion batteries have been used in a portable electric appliance such as a cellular phone, a personal digital assistance and a laptop computer, since they have good electrochemical performances. However they have a possibility of a leakage of the liquid electrolyte solution. Therefore, lithium ion polymer battery with a gel polymer electrolyte (GPE) is under developing to overcome the leakage problem.

A monomer for GPE is required that it has compatibility with the liquid electrolyte, ability to gel with a small quantity, stable structure not to decompose with cycling and good mechanical strength. Dipentaerythritol penta acrylate (DPEPA) is one candidate material for GPE, since it has five vinyl bonds at the end.

In this work, dipentaerythritol penta-/hexa- acrylate (DPEPA) was used as a monomer for the gel polymer electrolyte and the pouch-type cell was prepared to measured electrochemical performances.

Experimental

Polymerization was conducted at 60℃ for 60 minutes using bis (4-tert-butylcyclohexyl) peroxydicarbonate (BBP) as a thermal initiator and 1.1M $LiPF_6$/EC (ethylene carbonate) : PC (propylene carbonate) : EMC (ethylmethyl carbonate) : DEC (diethyl carbonate) (30:20:30:20 vol.%) as an electrolyte.

Lithium cobalt dioxide, mesophase carbon fiber (MCF) and polypropylene film were used as a cathodic active material, an anodic active material and a separator, respectively. $LiCoO_2$/GPE/MCF cells were also prepared and their electrochemical properties were evaluated at various current densities and temperatures.

Results and discussion

In the polymerization test using a glass tube, a translucent gel was obtained when the amount of the monomer was over than 2.0 vol% to the liquid electrolyte. The ionic conductivity of the GPE was about 5x 10^{-3} S cm^{-1} at room temperature. The GPE had good electrochemical stability up to 4.5 V vs. Li/Li^+. The cells with DEEPA-based GPE were performed good electrochemical performances such as rate capability and low-temperature performance. Figure 1 shows the discharge capacity of the cells with cycling at 0.5C current rate. Discharge capacity of the cell was very stable with charge-discharge cycling, showing over 98% of retention even after 100th cycle

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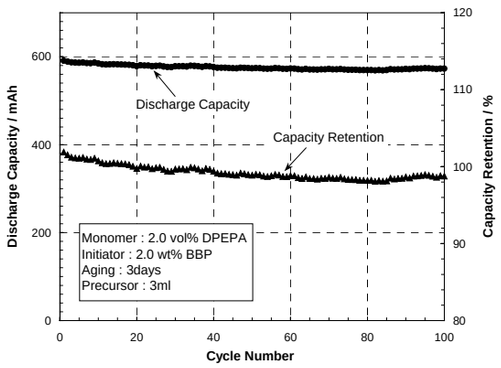

Fig. 1 Discharge capacity of lithium-ion polymer battery with DPEPA-based gel polymer electrolyte with cycling.