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Conducting polymer battery: Lithium-polyaniline system

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Doped polyaniline has been used as cathode material in lithium button cells. The cells were cycled under two different schedules and performances were compared. Dopant material also influences cycle life.

Key words: Polyaniline, lithium battery, conducting polymer

INTRODUCTION

Polyparaphenylene, polythiophene, polypyrrole and polyaniline have received a great deal of attention as materials for conducting polymers. These materials after doping have been used as cathode material in both aqueous and nonaqueous cells [1,2]. We have taken polyaniline (PAN) for our study.

EXPERIMENTAL

Doping of PAN

Polyaniline was obtained from aniline as reported earlier [3]. The base form of PAN was removed by filtration and washed repeatedly with distilled water. The wet cake obtained was once again suspended in 2N perchloric acid solution for 10 - 12 hrs and the perchlorate doped PAN was taken out by filtration and dried under vacuum.

Similar procedure was adopted to get the chloride doped PAN from the sulphate doped PAN. Purification and cell fabrication have been reported earlier [4].

The cells were discharged at 100 microamps till 1.4V to determine their capacity. Cycling test was done under two schedules:

Schedule 1: Discharge 100 microamps for 8 hrs.
Charge 50 microamps for 16 hrs.
Schedule 2: Discharge 100 microamps for 1 hr.
Charge 100 microamps for 1 hr.

Cut off voltage for discharge was 1.4.

RESULTS AND DISCUSSION

Both types of doped PAN cells had a capacity of 3 mAh at the first cycle. At the second cycle, the chloride-doped cell had 15.6 mAh and the perchlorate doped cell 9.6 mAh. But the chloride doped cell failed at the next cycle.

Under Schedule 1, the chloride doped PAN cell delivered 6 cycles before the cut off voltage was reached at the end of discharge. The other type of cell delivered 28 cycles. Cycling under Schedule 2 was conducted for perchlorate doped PAN cells only, since the other cell performed poorly. Perchlorate doped PAN cell had 230 cycles under Schedule 2. The cycling results are given in Figs. 1 and 2.

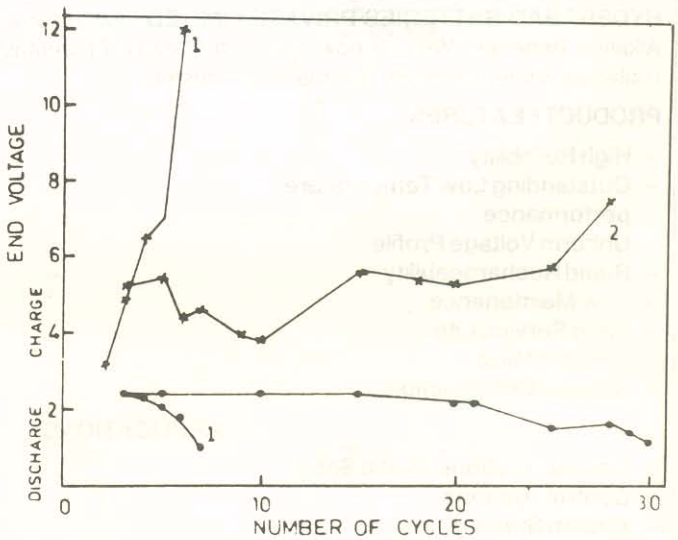

Fig. 1: Performance of Li/PAN cells under cycling schedule 1. (1) Chloride doped PAN (2) Perchlorate doped PAN

It is quite clear from the above result that the perchlorate doped PAN is having better performance as the cathode material in Li cells. The increase of charge voltage may be due to two reasons, one being the solid electrolyte film on Li and its reversibility problem and other the decomposition of PAN. Depth of discharge has also a certain effect on the cycle life. By suitably altering the cell

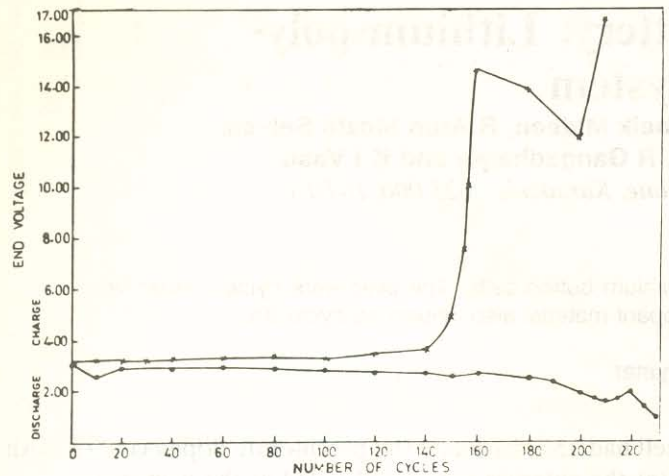

Fig. 2: Performance of perchlorate doped PAN in Li cells under cycling schedule 2

design and incorporating excess lithium, improvement in performance may be achieved. Replacement of propylene carbonate by one other solvent less reactive with lithium is also important.

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