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DISCHARGE CHARACTERISTICS OF NICKELOXIDE ELECTRODE PREPARED FROM ELECTROCHEMICAL IMPREGNATION

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Abstract

The improved method comprises electrochemically deposition of nickel hydroxide into the sintered nickel plaque cathode from nickel aqueous electrolyte at acid pH in a treating zone containing an anode. The electrochemical impregnation was examined under various conditions. Deposition condition of fine active material was obtained from the impregnation of a high temperature and also high current density. This method also could be decreased swelling and buckling of the plaque. A nickel electrode prepared by electrochemical impregnation is useful as the positive in nickel-cadmium cells. The utilization of the active material indicated almost 100% based on a one electron charge.

Key words : *Alkaline Storage Battery, Sintered Nickel Plaque, Cathodic Polarization, Nickel Positive Electrode, Electrochemical Impregnation*

1. Introduction

The nickel oxide electrode is used as the positive electrode of a nickel-cadmium secondary battery and also nickel-metal hydride secondary battery. Two methods are used, to the preparation of a nickel positive electrode generally. One is the chemical impregnation of the nickel hydroxide to inside of a sintered nickel plaque. The other is the filling of paste state nickel hydroxide to foam formation metallic porosity. These im pregnation methods are inappropriate in continuation operation, because they are complicated not only there are many process numbers. The electrolysis impregnation that can deposit nickel hydroxide directly inside the substrate by electrolysis is an excellent method[1]. However, as for this electrochemical impregnation method the selection of conditions of the electrolysis is difficult [2),3]. Because, the deposition form of the nickel hydroxide active material is changes. In this study, we researched about the various kinds condition of case that use a sintered nickel plaque about electrolysis impregnation method. And composing a nickel-cadmium cell, by using the electrode that prepared it we examined the cell characteristics.

2. Experimental

Electrochemical impregnation used the sintered nickel plaque of 83% porosity for the working electrode. In the case two electrolysis-nickel plates were configured to counter electrodes. An electrolyte used the nickel nitrate aqueous solution of a concentration 1.0~3.0mole/l(=M). Conditions of impregnation were current densities of 1~4A/dm^2, electrolysis time of 1~4hours and the temperature was 30℃ or 80℃. After impregnation, thickness change of nickel plaque and loading level of nickel hydroxide were measured. Thereafter, nickel-cadmium cells were composed with sintered cadmium electrode. The capacity change was measured by the rate of 0.2CA and temperature of 28℃. The surface view of cycled nickel positive electrode was observed by scanning electron microscope.

3. Results and Discussion

A representative electrochemical impregnation condition is shown in Table 1. The good deposition of nickel hydroxide was obtained by the impregnation with the condition of the high temperature and also high current density by using the electrolyte of high concentration. However, using the electrolyte of low concentration, the impregnation under the low temperature and also low current density needed long time to the deposition of nickel hydroxide (Table 1, plate No.1). Moreover, nickel hydroxide was deposited in the surface neighborhood of the plaque and increased the thickness of the electrode fairly.

The discharge curves for the nickel cadmium cells using these positive electrodes is shown in Fig. 1. Each curves shown at the time of initial stable discharge capacity. From this figure, the electrode that the fine deposition of nickel hydroxide was obtained in impregnation, the nigh utilization of active material was obtained (Fig.1, plate No.5). The electrode that nickel hydroxide was deposited in the surface neighborhood of nickel plaque discharge capacity was decreased, because the active material dropped out from plaque between charge-discharge cycles (Fig.1, plate No.1).

Fig. 2 shows the surface view of various nickel positive electrodes. Fig. 2a suggest that the pore of sintered nickel plaque was choked considerably by deposited nickel hydroxide. Consequently it may be late of transfer of KOH electrolyte ion

Table 1. Conditions of Electrochemical Impregnation

No. of plate	Conc. Of $Ni(NO_3)_2$/M	Temp. /℃	C.D. /A·dm^{-2}	Time of impreg./h	Loading level of $Ni(OH)_2$/g
1	1.0	30	1.0	2×2*	3.7155
2	3.0	30	4.0	1	3.5233
3	1.0	80	1.0	2	3.5117
4	2.0	80	3.0	1	3.4556
5	3.0	80	3.0	1	3.3267

*2hours 2times

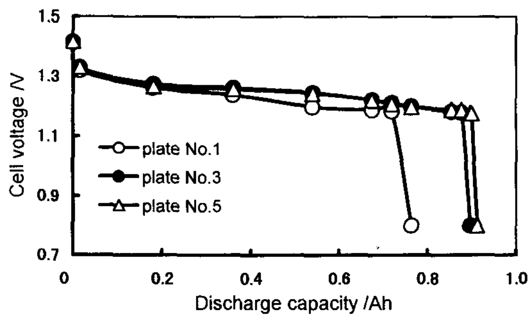

Fig. 1 0.2C discharge curves of various nickel positive electrodes at 28℃ Utilization of active material of each positive electrodes are 71.14 %(No.1), 88.37%(No.3), and 94.90%(No.5) respectively.

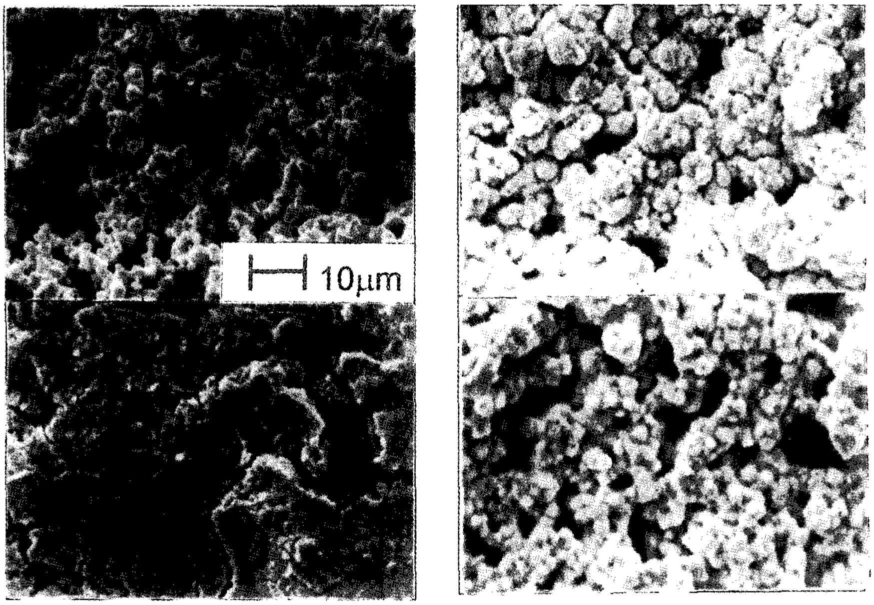

Fig. 2 Scanning electron micrographs of nickel positive electrodes
(a) Sinter nickel plaque (b) Plate No.1
(c) Plate No.3 (d) Plate No.5

into pore of plaque with change and discharge cycles. Fig. 2d shows a good morphology.

4. Conclusions

The electrochemical impregnation of sintered nickel plaque from a high temperature and high current density of acidic bath of nickel nitrate yields high loading level of active material. This high loading is effectively utilized in the flooded formation nickel-cadmium cells.

REFERENCES

1. L.Kandler, U. S. Pat. 3, 214, 355 (1965)
2. Youichi Kikuchi, Tadahiko Ogawa, Kunio Hasegawa and Kuranobu Sugita, DENKIKAGAKU, 50, p.237 (1982)
3. Yasushi Sasaki and Tsugito Yamashita, HYOMEN GIJUTSU, 48, p.659 (1997)