Thin Film nano-MnO_2 Electrode Prepared by Computer Jet- printing technique

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Introduction

Recent years many researchers pay attentions to thin film micro-batteries (TFB) due to its great ability to the micro-power of MEMS devices and micro-electronic circuits. Usually the ways to fabricate TFB are radio-frequency magnetron sputtering method [1], and laser sputtering method [2]. It needs very good equipments and the fabrication speed is limited. In this paper, we introduce a very simple method in which the computer jet-printing technology was used to fabricate a very thin electrode. By use of a jet-printer, we have prepared thin film nano-MnO_2 electrode. Its electrochemical properties were investigated by measuring the voltammograms and impedance spectra.

Experimental

Photo-paper was used as the matrix of electrode. At first it was painted by polypropylene chloride dimethyl benzene solution. Then after drying, the surface was covered a thin gold layer by vacuum sputtering technique. A jet-printer model Lexmark-3200 was used for printing the thin film electrode on the surface of gold modified paper, while its ink was replaced by a suspension solution, containing nano-MnO_2 powder (Gaosida Company, China) and polymer gel materials. After printing and drying, the thin film nano-MnO_2 working electrode with area of 0.5cm×0.7cm was obtained. The shape of electrode can be designed by computer designing. The thickness of electrode can be adjusted by controlling the concentration of suspension solution and the repeated printing times. The test solution was 2M NH_4Cl + 1M $ZnCl_2$. A Zinc electrode was used as reference electrode.

Results and discussion

The working electrode was constructed by nano-MnO_2 particles with diameter about 30 nanometer as shown in Fig.1. There are many small holes between particles. Fig 2 shows the profile of working electrode. From that the thickness of MnO_2 layer can be determined as 10 μm. The voltammogams of nano-MnO_2 is presented in Fig.3. In the first cycle there is a sharp symmetric cathodic peak, which corresponds to the reduction of MnO_2 to MnOOH. It performs the typical character of thin film electrode. In second cycle the peak does not appear, because MnO_2 was used up during first cycle. The peaks located near 0.93V are caused by the reduction of MnO_2, which was produced via the disproportionation reaction of MnOOH. The anodic peaks appeared at near 1.05V correspond the oxidation of dissolved Mn^{2+} ions. The voltammograms of thin film nano-MnO_2 electrode present the electrochemical characteristic of MnO_2 more clearly than that of electrodeposited MnO_2 / Pt electrode or common MnO_2 electrode.

Moreover it is easy to achieve thin flexible batteries by using computer jet-printing thin electrodes and polymer separators technology.

Acknowledgement

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References

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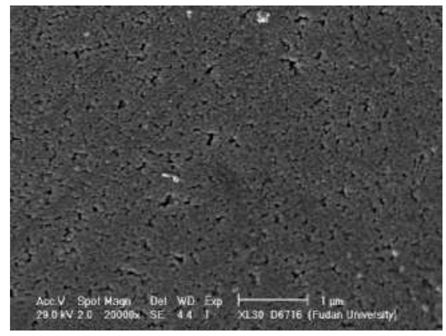

Fig.1 The SEM image of a jet-printing nano-MnO_2 electrode surface.

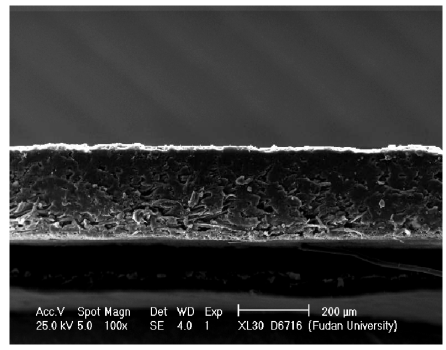

Fig.2 The SEM profile of working electrode.

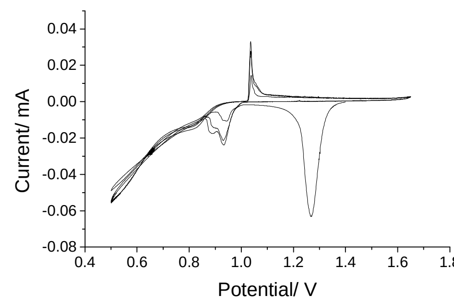

Fig.3 voltammograms of thin film nano-MnO_2 electrode in 2M NH_4Cl + $ZnCl_2$ solution, scan rate: $1mVs^{-1}$.

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