고분자 겔 전해질에서 망간산화물의 초고용량캐페시턴스 특성

Capacitance properties of MnO_2 in the hydrogel electrolytes

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Key words : supercapacitor, gel electrolytes, nanowire-structured MnO_2

1. Introduction

The electrochemical capacitors are expected to be useful for high power applications due to its high-power capability[1,2].

Electrochemical capacitors have mainly composed of cell chemistry with liquid solution electrolyte, but have problems associated with electrolyte leakage and corrosion. Therefore, liquid electrolytes have been replaced with solid and gel electrode to enhance the safety and reliability of its own performance.

In the present work, nanowire-structured MnO_2 electrodes are prepared by a sonochemical method. Their supercapacitive properties are investigated by the cyclic voltammetry in the different PAAK - based hydrogels, including PAAK and potassium polyacrylate-co-polyacrlamide (PAAK-co- PAAM) and compared with other cells proposed K.T. Lee et al[1].Thus-prepared cell chemistry of nanowire-structured MnO_2 and hydrogel electrolytes displays an excellent specificc apacitance in the thick electrode.

2. Experimental

Amorphous MnO_2 was synthesized by sonochemical methods where in potassium permanganate and manganese(II) acetate.

To prepare thick film electrodes, slurry containing the oxide powder, carbon black (CB;Vulcan XC72), and polyvinylidene difluoride (PVDF, Aldrich) was pasted onto a Ti foil. On the dry basis, the oxide to CB ratio was fixed at 7:3, while the binder (PVDF), which used N-methyl pyrrolidone (NMP, Mitsubishi Chemical) as the dispersing solvent, had a weight composition of 15% in the final electrode. Such a high binder content (15 wt%) employed in the present study was intended to give sufficient binding strength to minimize capacitance fading due to deterioration of electrode structure]. The electrodes typically had a dimension of 1 cm×1 cm and contained 1.02 (±0.03) mg of active materials including the oxide and CB particles.

The two polymers employed for making the GPEs are PAAK(Aldrich, CAS# 25608-12-2) and PAAK-co-PAAM (Aldrich, CAS#31212-13-2). Both polymers are partially cross-linked, and have been used as received. The resulting polymer gel electrolyte consisted of 9 wt% polymer, 6.7 wt% KCl, and 84.3 wt% H_2O. Cyclic voltammetry (CV) measurements were conducted with an electrochemical analyzer (AUTOLAB, Eco Chemie PGSTAT30). Cyclic votammograms (CVs) were acquired with a two-electrodes of 1cm apart, while single-electrode CVs were recorded with a three electrode configuration with Ag/AgCl saturated KCl (Eg&G, 197mVversus SHE at 25℃) reference electrode.

3. Results and Discussion

Figure 1 shows SEM and High-resolution transmission electron microscopy (HR-TEM) of the as-prepared sample, in which the nanowire structured MnO_2 composed of one dimensional nanoarrarys about 300-700nm of the length and 10-50 nm of the diameter, whereas the nanowires formed many defects on the walls to increase specific surface area, i.e, 250 m2g-1. The corresponding selected area electron diffraction (SAED) pattern showed the faint ring image and displays the amorphous structure of MnO_2. In the morphologies of the nanowire structured MnO_2, one dimensional nanoarrarys show a plenty of the room, facilitating the electrolytes penetrating into the thick-film electrode.

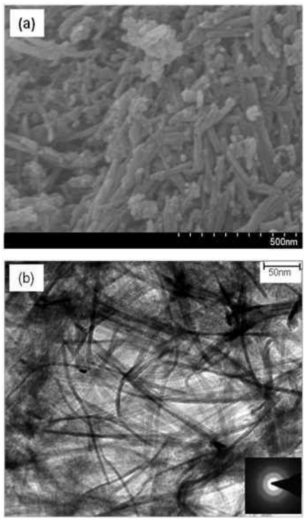

Fig. 1 (a) SEM and (b) HR-TEM image of the prepared nanowire structured MnO_2.The inset shows the SEAD Pattern.

Fig. 2 summarizes the specific capacitance for the different electrolyte at the various scan rates. The cells composed of nanowire-structured MnO_2 and hydrogelel ectrolytes showed the higher specific capacitance than the liquid electrolyte cell, especially the PAAK cell having the highest specific capacitance under test conditions. At a scan rate of 4 mVs-1, the specific capacitance of nanowire-structured MnO_2 is 250 Fg-1 for the liquid electrolyte cell, 485 Fg-1 for the PAAK cell, and 380 Fg-1 for the PAAK-co-PAAM cell. The 94% and 52% increase inthe specific capacitance for the PAA and PAA-co-PAAM hydrogel cells, as compared with the liquid electrolyte cell. Details will be discussed in the presentation.

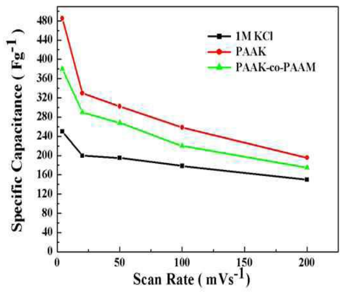

Fig. 2 Specific capacitance of the nanowire structured MnO_2 cells at the various scan rates.

4. Conclusion

Nanowired structured MnO_2 with PAAK hydrogel electrolytes shows the higher specific capacitance, i.e., 485 Fg-1, which is enhances 91%, than that composed of conventionally MnO_2 by precipitate method, and lower the charge-transfer resistance of the PAAK and PAAK-co-PAAM than that of the liquid electrolyte. Thus, it is suggested that the cell composed of nanowired structured MnO_2 is more suitable for the PAAK hydrogel electrolyte in the supercapacitors.

Acknowledgment

This study was supported by a grant from the cooperative R&D Program (B551179-10-01-00) funded by the Korea Research Council Industrial Science and Technology, Republic of Korea

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