

Carbon nanotubes lined by anodic deposition of MnO₂ for supercapacitor application

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Supercapacitors are energy storage devices that fill the gap between batteries and conventional capacitors, i.e. they have a specific power as high as conventional capacitors and a specific energy close to that of batteries [1]. They store electrical energy using either double-layer charging or fast surface redox reactions (pseudo-capacitors) [2]. Due to their outstanding properties (mechanical, electrical and thermal) and large surface area (1 to > 2000 m²·g⁻¹) carbon nanotubes (CNTs) are suitable materials for the development of supercapacitors.

A dielectric layer of MnO₂ was anodically deposited lining the surface of CNTs (20-30 nm in diameter and about 10 μm long) previously grown by means of plasma enhanced chemical vapor deposition (PECVD) (Figure 1). This new method is characterized by the anodic deposition of MnO₂ on CNTs in conditions of low Mn²⁺ concentration, providing a slow diffusion that warrants an homogeneous lining of the CNTs. On the other hand, this method avoids the kite growth of manganese dioxide on CNTs. The electrochemical properties of the obtained electrodes were characterized using cyclic voltammetry with scan rates ranging from 10 to 150 mV·s⁻¹, galvanostatic charge-discharge techniques and impedance spectroscopy (in the range 10⁻¹ - 10⁴ Hz). The improvement of the electrochemical characteristics of the electrodes (showing up to 642 F·g⁻¹ of specific capacitance) has been discussed in terms of the morphology and structure of the samples analyzed by scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

References

- [1] C. Peng, S. Zhang, D. Jewell and G.Z. Chen, Prog. Nat. Sci., **18** (2008) 777.
- [2] P. Simon, Y. Gogotsi, Nature Mat., **7** (2008) 845.

Figures

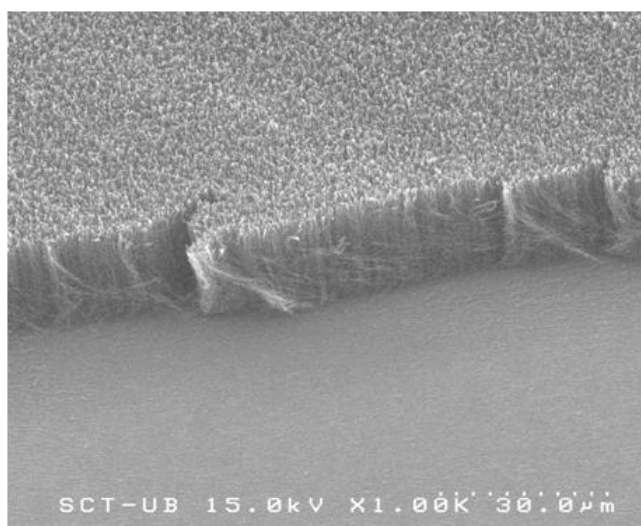


Figure 1. Vertically aligned CNTs (VACNTs) obtained by means of PECVD. Fe catalyst thickness layer: 3 nm, annealing temperature: 680°C.