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Carbon nanotube/polymeric electrolyte interface

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Abstract – Double-wallled carbon nanotubes (DWCNT) functionalized with carboxyl groups were used to prepare electrodes impregnated with polymeric electrolyte based in a block copolymer and $LiN(CF_3SO_2)_2$. The main goal is to investigate the solid interface between carbon nanotube and ionic conductor polymer. The electrochemical cell DWCNT/polymeric electrolyte/DWCNT was characterized by impedance spectroscopy and cyclic voltammetry.

Carbon nanotubes have been applied as electrode components for electrochemical devices such as batteries and supercapacitors [1]. The effective increase of electrode's surface area increase the risk of electrolyte decomposition and the use of solid polymeric electrolytes can contribute positively to face this issue [2]. The interface between carbon nanotubes and polymeric electrolytes was investigated in this work to support further studies of flexible, safe and thin storage and conversion devices [3].

Ethylene oxide-ethylene based block copolymer was used to dissolve various contents of $LiN(CF_3SO_2)_2$. The polymeric electrolytes were fully characterized in relation to their structure and properties. Carboxyl functionalized double-walled carbon nanotubes (DWCNT) have been dispersed in solvent and coated in metallic substrate. The carbon nanotube coatings showed a conductivity of 1 Scm^{-1} and high porosity as evidenced in Figure 1. Fully impregnation of the nanotube coatings with polymeric electrolyte leads to a nanocomposite with conductivity of 10^{-2} Scm^{-1}. Impedance spectroscopy and cyclic voltammetry (Fig. 1) were used to study symmetrical cells of DWCNT/polymeric electrolyte/DWCNT by varying temperature and voltage range.

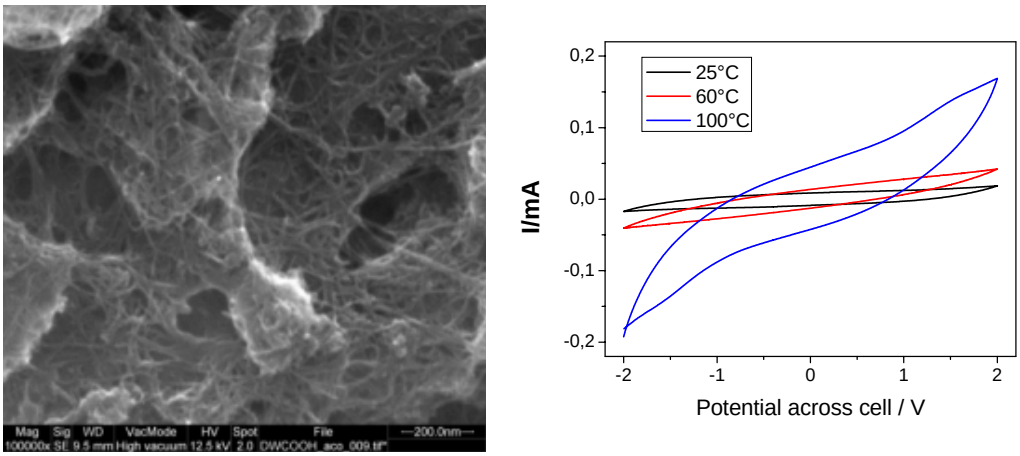

Figure 1. SEM image of DWCNT coating on metallic substrate and cyclic voltammetry curves (10 mV s^{-1}) for the DWCNT/polymeric electrolyte/DWCNT at three temperatures.

The electrochemical stability window is higher than 4V at 25 °C and 60 °C as can be observed in Fig. 1. The impedance Nyquist plot for the device can be adjust with a equivalent circuit $R_1(R_2C)$, contact resistance R_1 in series with a R_2C for the nanocomposite/electrolyte interface. Capacitances of 1Fg^{-1} to 6 Fg^{-1} (F/total carbon weight) have been determined from the voltammetric curves between 25 °C and 100 °C.

References

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