

Effect of propargyl methacrylate as electrolyte additive on electrochemical performances of mesoporous carbon microbead based anodes at elevated temperature

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Abstract

Among the most promising kind of energy storage materials, lithium ion batteries (LIBs) have been widely used in many electronic devices viz., electronic watch, cell phones, laptop computer and electric vehicles, due to their excellent performance in terms of energy density and low cost of maintenance over other batteries [1]. During the initial charge of LIB, the electrolyte can undergo reduction process at the graphite surface and forms a passive layer (solid electrolyte interphase, SEI). It consumes part of the lithium ions in the SEI layer formation process, making the initial charge-discharge irreversible process. However, it effectively prevents the electrolyte from further reduction reaction with the surface of the carbon negative electrode, thereby protecting the structure of the graphite electrode [2]. Hence, SEI film can improve the cycle life and safety of LIBs. Hence, the incorporation of an additive to the electrolyte can enhance the quality and composition of the SEI.

In the present investigation, the influences of propargyl methacrylate (PMA) as an electrolyte additive, on the formation of SEI passive film and interfacial behaviour during cycling performance were studied. Galvanostatic studies, X-ray photoelectron spectroscopy (XPS), and scanning electron microscopy (SEM) were used to examine the SEI layer behaviour, surface morphology, and its chemical compositions at elevated temperature on the mesoporous carbon micro beads (MCMB) electrodes. In order to explore the reaction mechanism of the formation of SEI, a series of analysis were carried out viz., XPS, ATR FT-IR and TGA studies. All the studies suggesting that the 0.5 wt.% PMA exhibits the better electrochemical performance at room temperature and 55 °C. The triple and double bonded functional groups were able to get polymerized and form a stable SEI with dense and low impedance behavior, which can efficiently minimize the decomposition of the electrolytes as evidenced by the EIS analysis (Fig. 1). Consequently, the electrochemical stability of the formed SEI film considerably improved by the introduction of PMA electrolyte additives on MCMB half-cell

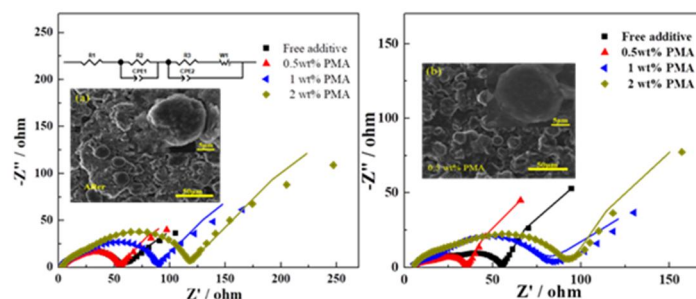


Fig. 1 Nyquist representation of impedance spectra of MCMB anode half-cell after (a) 3 cycle and (b) 50 cycle in 1M LiPF₆ EC/DEC with different PMA concentration at room temperature. (inset) SEM micrograph of 0.5 wt.% PMA after cycling performance test.

References:

1. M.R. Palacin, Chem. Soc. Rev. 38 (2009) 2565-2575.
2. Q. Pan, K. Guo, L. Wang, S. Fang, J. Electrochem. Soc. 149 (2002) A1218-A1223.