Electrochemical Deposition of Lithium Phosphate Films for Battery Applications

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Li-ion batteries (LIBs) posse a combination of high energy and power density, which makes them attractive candidate for the use in portable electronics, power tools and high-power applications such as electric or hybrid vehicles. However conventional LIBs with liquid electrolyte are potentially dangerous items, what proved by widely publicized incidents with fire or explosion of mobile phones. Generally, LIB can rupture, ignite, or explode when exposed to high temperature or short-circuiting. There are several ways to increase the safety of LIBs: modification of cathode material to improve its thermal stability and reduce heat generation during the cycling; improvement the thermal stability of solid electrolyte interface (SEI), addition of flame retardant to the battery components. The alternative way is development of all solid-state LIBs. In this study, we focused on lithium phosphate (LPO) synthesis because this material can be used as SEI or solid electrolyte depending on the structure of grown material. The purpose of the work is developing of simple and reliable method of LPO synthesis with desired structure. One of the methods allowing the controlled structure to be realized is electrochemical deposition. An electrochemical cell in tree-electrodes configuration was used with platinum mesh as a counter electrode and saturated Ag/AgCl as a reference electrode. Indium-tin oxide coated glass used as the substrate (working electrode). The deposition of LPO was performed at room temperature in the electrolytic bath composed of an aerated aqueous solution containing 0.02 M H_6NO_4P, and 0.5 M $LiNO_3$ (pH=4.6) [1,2]. The solution stirred during the electrodeposition process at 600 rpm. The films were obtained in chronoamperometric mode in the range of voltages between -0.25 and -3.25V. The results reveal that structure of grown film strongly depends on the applied voltage. More details about crystalline structure, conductivity and other properties will be presented and discussed during the conference.

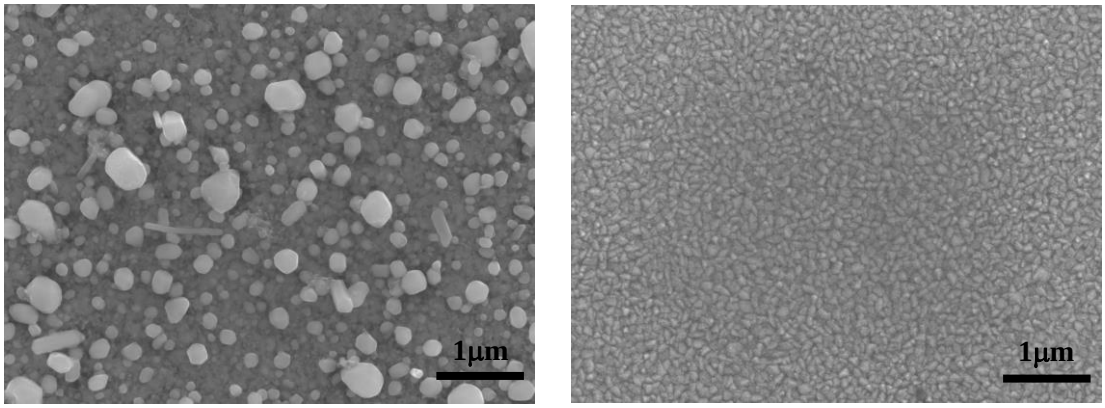

Fig. 1 SEM images of LPO films obtained at -1.8 V and -1.25V

[1] H.C. Liu, S.K. Yen, J. Power Sources. 159 (2006) 245–248.

[2] M.C. López, et al., ACS Appl. Mater. Interfaces. 6 (2014) 5669–5678.

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