Thin Film Lithium Ion Batteries for High Power Density Storage - Status and Perspective

Stamate, Eugen; Christiansen, Ane Sælland

Publication date:
2013

Thin Film Lithium Ion Batteries for High Power Density Storage - Status and Perspective

Eugen Stamate[1] and Ane Christiansen[1]

[1]*Department of Energy Conversion and Storage, Technical University of Denmark, Frederiksborgvej 399, Roskilde 4000, Denmark*
E-mail: eust@dtu.dk

Wireless and portable electronic devices enhanced drastically the speed and effectiveness of information flow exchanged in our society. A common requirement for these devices is a portable power source (battery) that needs to be compact, of low weight and of high power density. Thus, improving the performance (capacity, lifetime and safety) and lowering the cost of batteries is a critical goal under stringent need for development. Comparative to crystalline electrolytes, thin film amorphous materials are the very promising candidates due to their capability of single ion conduction, isotropic properties, and absence of grain boundaries. So far there are two relevant materials used for electrolytes: Lipon and lithium thio-germanate. Despite of extensive research, the mechanism to explain and control the ionic conductivity in Lipon is not understood, while thio-germanate thin films are yet difficult to produce.

The aim of this work is to review the current status on Lithium ion batteries based on Lipon electrolyte and present new results on Lipon thin films produced by RF sputtering. Experiments are performed in a conventional RF sputtering system and also in a ECR plasma assisted RF sputtering setup consisting of a matrix configuration of distributed plasma cells placed at the top of a 40×40×40 cm vacuum chamber. The ECR cells can produce uniform plasma in a pressure range from 10 down to 0.1 mTorr. A 2 inch magnetron sputtering cathode is placed on the lateral side facing the head of a Hiden mass spectrometer. A Langmuir probe and an optical fiber are inserted perpendicular to the direction of the mass spectrometer and cathode as to measure plasma parameters and optical emission spectra. The target made of Li_3PO_4 is provided by Kurt Lesker ®. Lipon films are deposited onto Au-coated silicon substrates using different values for N_2 flow and RF power in a controllable nitrogen flow. Impedance spectroscopy, FIB-SEM and SEM are used for film characterization.