TF-7-Or-3
Thin-film lithium battery materials

T14 Thin Films

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J. Ribeiro [1], R. Sousa [1], J.A. Sousa [1], L.M. Goncalves [1], M.M. Silva [2], L. Dupont [3], J.H. Correia [1].

[1]Algoritmi centre, University of Minho - Guimaraes (Portugal), [2]Chemistry centre, University of Minho - Braga (Portugal), [3]LRCS – UMR 6007, Université de Picardie Jules Verne - Amiens (France).

Batteries are crucial for electronic autonomous and portable devices. The size of these devices is a huge challenge, because the miniaturization is increasingly important [1]. The thin-film batteries allow a lighter and small package because no liquids or polymers are used. This technology also increase the safety because no leaking or explosion could occur and the energy density [2]. The thin-film batteries can be fabricated using only physical vapour deposition techniques [3].
A battery is composed by two current collectors, two electrodes and one electrolyte. The electrolyte is an electrical isolator and an ionic conductor to allow the lithium ions pass through it, but not the electrons. The electrolyte selected in this work was lithium phosphorous oxinitride, deposited by RF sputtering, previous reported by our group [4]. The positive electrode selected was lithium cobalt oxide ($LiCoO_2$). The positive electrode (cathode) is where reduction reactions occurs. The $LiCoO_2$ was deposited by RF sputtering with power source of 150 W, deposition pressure of 3×10^{-3} mbar, Ar flow of 40 sccm, a deposition rate of 3,2 Å/s and a thickness of 700 nm. An annealing of 2h at 650 ºC in vacuum was performed for enhance the crystallization and consequently, the capacity of $LiCoO_2$ receive and deliver lithium ions. The oxidation reaction occurs in the negative electrode (anode). The metallic lithium was selected and fabricated by thermal evaporation, with 3 µm thickness. The cathode and anode current collectors were selected to ensure an excellent electrical conduction without reacting with the respective cathode and anode materials selected before. Platinum was selected for $LiCoO_2$ current collector and titanium for metallic Li current collector.
Thin-film lithium battery materials were deposited and characterized in this work. The materials are deposited one after another till the battery is completed. The design for the battery is presented in figure 1 and materials indicated. This design is archived by using shadow masks during depositions.

Supported by FCT with PTDC/EEAELC/114713/2009 and SFRH/BD/78217/2011.

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Fig.1: Thin-film lithium battery design with current collectors, cathode, electrolyte and anode indication (not on scale for better visualization).