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THIN-FILM IMPROVED MATERIALS FOR SOLID-STATE LITHIUM BATTERIES

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One of the huge challenges of 21st century is the energy storage. The increasing miniaturization of electronic devices requires the miniaturization of devices that provide energy to them. Autonomous devices of reduced consumption are increasingly common and they have benefited from energy harvesting techniques. However, these devices often have peak power consumption, requiring the storage of energy. Batteries are ideal power source devices because they provide stable voltage and allow the levelling of energy consumption.

This abstract presents the fabrication and characterization of improved thin-films for solid-state lithium battery construction. The solid-state batteries are ideal for microelectronics manufacturing techniques because all constituent materials are solid and intrinsically safe. Lithium batteries are composed primarily of three materials, the cathode, electrolyte and anode. The positive electrode (cathode) and negative (anode) have high electrical conductivity and capacity of extraction and insertion of lithium ions. The electrolyte's main features are the high ionic conductivity and high electrical resistivity. The materials chosen for the battery are lithium cobalt oxide (cathode), lithium phosphorus oxynitride (electrolyte) and lithium metal (anode).

The lithium cobalt oxide ($LiCoO_2$) was deposited by RF sputtering and characterized using the techniques XRD, EDX, SEM and electrical resistivity measured with van der Pauw technique. Fully crystalline $LiCoO_2$ was achieved with an annealing of 650 °C in vacuum for two hours. Electrical resistivity of 3.7 Ωmm was achieved.

The lithium phosphorus oxynitride (LIPON) was deposited by RF sputtering and characterized using the techniques EDX, SEM, impedance, DSC and TGA. Ionic conductivity of 6.3×10^{-7} Scm^{-1} for a temperature of 26 °C was measured. It was also proven the thermal stability of LIPON up to 400 °C.

The metallic lithium (Li) was deposited by thermal evaporation and its electrical resistance measured at four points during the deposition. Resistivity of about 10 μΩm was measured. The oxidation rate of the lithium in contact with the ambient atmosphere was evaluated.

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