Passivation phenomena

Lithium is among the most reactive elements. It easily reacts with a number of substances, including water and air. Because of this high reactivity, the commercial exploitation of lithium based electrochemical systems has been for long time hindered by the reaction between lithium and several electrolytes. Only in the 80s, suitable electrolytes were developed, based on aprotic organic solvents. The reason for the stability of electrolytes based on organic solvents lies in the passivation layer that is built at the lithium surface.

This protective layer (also called SEI, Solid-Electrolyte-Interphase) stops the reaction between electrolyte and lithium and due to its mechanical characteristics, ensures good stability for long times. Therefore, the formation of a layer of right properties is a key element for the achievement of long-term storage properties.

A number of factors, including the formulation of the electrolyte and the production conditions, influences the formation of the SEI layer. In addition, a particular step of the manufacturing process plays a decisive role in the formation of the right SEI layer: the pre-discharge step (i.e. a discharge limited to some percentage of the theoretical capacity of the cell) of 100 % of the produced cells. By carefully controlling the pre-discharge parameters, a passivation layer of optimized physical-chemical characteristics is created at the interphase lithium-electrolyte.
Unlike other lithium-based battery technologies, a passivation layer of growing thickness does not characterize the CR (Li/MnO_2) system after long-term ageing of the cells or after short exposures at high temperature. The SEI layer of CR cells built at the beginning does not change significantly even after years of storage at controlled temperature (see related section in this chapter – FAQ about recommended storage conditions). In other lithium systems, instead, a growth of the layer with ageing time, is observed, turning out in a reduced pulse capability (the well-known «voltage delay effect, especially observed for liquid cathode systems when trying to request high pulses after long time storage at room temperature, or after short periods at high temperature). For these other lithium systems, it is necessary to apply a continuous load of low current to minimize passivation phenomena; on the contrary, for CR systems this precaution is not necessary.