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Comparison between noise level and differential capacity of Li-Ion batteries at different temperatures

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Differential capacity analysis and electrochemical noise measurements are the promising ways in this direction. Using recorded voltage, these techniques provide some descriptors which can be used for characterization of the system state. Sure, physical interpretation of these descriptors is usually an open question but the same difficulty meets by the electrochemical impedance spectroscopy and other methods due to complexity of the processes in electrochemical sources of energy. The first step deals with investigation of descriptors sensibility and with the development of qualitative models which reflect the main phenomena governing the behaviour of electrochemical systems. Fig.1 present the differential capacity for an ICR18650-26 Li-Ion Samsumg element (3.7 V; 2600 mAh) obtained with a 1 A current load in discharge. Fig. 2 presents the magnitude of the noise versus the state of charge (SOC) for the same battery. For 40% of SOC we have both the maximum for the differential capacity and the minimum of the noise. Electrochemical noise diagnostics (END) has been applied to commercial Li-ion batteries. This diagnostics is based on recording small voltage fluctuations of the battery during discharge. In order to avoid apparatus noise the direct measurements of voltage have been used without filtering and statistical descriptors of process have been calculated namely standard deviation (STD), skewness (SK) and kurtosis (KU). It was demonstrated that the noise increase drastically at the beginning (SOC>97%) and the end (SOC<4%) of the discharge. The noise is quasi-uniform and non-Gaussian with SK=0 and KU=-1.2. In the boundaries between the beginning and the middle and between the middle and the end, an important variation of SK and KU has been detected. The aim of this paper is to study the link between the noise and the differential capacity for different temperatures.

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