

Extended model of Li-ion batteries^{*}

Dr. Eng. Yasser Diab^{**}

Abstract

The objective of this research is to understand and model the fundamental phenomena of Li-ion batteries (electric double layer and charge transfer), and also to investigate the variation of the battery characteristics under different operating conditions. These phenomena are modelled using an electrical equivalent circuit with short and long term time constants. The pulse discharge method is used to determine the battery model parameters and to identify the variation of the battery capacity as a function of the discharge rate. The non-linear relation between the model parameters and the state of charge is described by mathematical equations extracted from experimental results using the fitting technique. The temperature and the aging effects on the battery characteristics are identified based on literature results. Consequently, an extended model of Li-ion battery is established in the Matlab environment. The simulation and the experimental results are analysed and compared at the different operating cases.

Keywords: Li-ion battery, electric double layer, charge transfer, electrical equivalent circuit, discharge rate, state of charge, temperature, aging, pulse discharge method, fitting.

^{*} For the paper in Arabic see pages (11-22).

^{**} Faculty of mechanical & electrical engineering, Damascus university.