4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

Identification of parameters of the fractional model of supercapacitors

Jose J. Quintana*, Alejandro Ramos and Ignacio Nuez

Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería (IUSIANI), Universidad de Las Palmas de Gran Canaria, 35017, Campus de Tafira, Las Palmas, Spain

Accepted for publication on 9th March 2015

Electrochemical double layer capacitors (EDLC) also known, as supercapacitors are devices used mainly for energy storage. In these devices, diffusion phenomena play an important role in its behavior due to its internal structure.

Fractional mathematics is often used in fields such as electrochemistry, diffusion processes, control applications, study of electric transmission lines, etc. In this paper it will be proposed a mathematical model based on fractional mathematics that relates the voltage and current in an EDLC in the time domain. The reason for this model is that traditional models fit well on charging and discharging phases, but not in the resting phase. The proposed model is based on the classic model formed by an ideal capacitor with a series resistor and a parallel one, in which the ideal capacitor has been replaced by a fractional one. This results in a fractional transfer function, i.e. with terms of s to the power of not integer values. To obtain the temporal response of the function to an arbitrary input, it is necessary to use numerical methods. Due to its form the Mittag-Leffler function was used for its resolution.

To test the model, it has been used empirical data from several EDLCs. The parameters used for the adjustment are the serial and parallel resistance, the capacitance of the capacitor, and its fractional index. The model was checked during charging, discharging and resting phases, showing a significant improve compared to the similar classical models. It has also been tabulated the parameters of the model for each of the tests.

The copyright of the Abstract belong to the authors. The North Sea Conference & Journal Ltd has a right to publish the Abstract on the conference website.

Keywords: Supercapacitor; fractional calculus; fractional model