Data Article

Experimental data on open circuit voltage characterization for Li-ion batteries

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A R T I C L E   I N F O

A B S T R A C T

In this article, we present the datasets collected from nine different Li-ion batteries. These datasets contain voltage, current and time measurements during a full charge-discharge cycle of a battery at very low current (that is nearly at $C/30$ rate). Such low current rate data is suitable for open circuit voltage characterization. The collection of this data was done through the use of an Arbin battery cycler and a thermal chamber was used to control the test temperature. Data were collected over a wide range of temperatures from $-25\,°C$ to $50\,°C$.

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Specifications Table

| Subject	Energy
Specific subject area	Open circuit voltage characterization for rechargeable batteries
Type of data	Table, Figure and CSV data-file
How data were acquired	Arbin BT-2000 battery cycler, Tenney T2C thermal chamber
Data format	Raw, analyzed (Processed)
Parameters for data collection	The thermal chamber was used to control the test temperature.
Description of data collection	The Arbin battery cycler was connected to the battery under testing to collect measurements such as voltage, current and time.
Data source location	Institution: University of Connecticut City: Storrs, CT Country: USA Latitude and longitude for collected data: 41.8077 N, 72.2540 W
Data accessibility	Repository Name: Mendeley Data Data identification number: 10.17632/sb993dhjnz.1 Direct URL to data: https://data.mendeley.com/datasets/sb993dhjnz/draft?a=de3a9630-4ac8-43cd-84f0-8acee05edc1f
Related research article	Mostafa Shaban Ahmed, Sheik Arif Raihan, Balakumar Balasingam,"A Scaling Approach for Improved State of Charge Representation in Rechargeable Batteries", Applied Energy, Volume 267, 2020, 114880. [1] B. Pattipati, B. Balasingam, G.V. Avvari, K.R. Pattipati, Y. Bar-Shalom, "Open circuit voltage characterization of lithium-ion batteries", Journal of power sources 269, 317-333. [2]

Value of the Data

- This data provides voltage, current and time measurements that can be used to estimate the open circuit voltage parameters.
- Data at different temperatures provides a way to compare open circuit voltage modelling against temperature.
- Identical data collection procedure was followed on all battery cells of the same model; this allows to compare the change in state of charge characteristics of different battery cells of the same type.
- Data form multiple battery models can be used to train machine learning algorithms by automated battery management algorithms.

1. Data Description

Each raw data file (stored in comma separated values (CSV) format) contains voltage, current and time stamps at a certain temperature. Table 1 shows the number of cells tested at each temperature. The files are named according to the following format: "battery name"_"serial number"_"temperature"_"cell number". For example a file named "Sam_EB555157VA_n15_1" is for a Samsung battery with serial number "EB575152VA" where the test temperature was −15 °C and this data is for the cell numbered 1. A file named "Nokia_BP_4L_p30_4" is for a Nokia bat-

Table 1
Number of cells tested for each temperature.

Temp (°C)	Capacity (Ah)	−25	−20	−15	−10	−5	0	5	10	15	20	25	30	35	40	45	50
Samsung EB575152VA	1.5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
LG LGIP-530B	1.1	2	2	1	2	1	2	2	2	2	2	2	2	2	2	3	2
Nokia BP-4L	1.5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Blackberry RIM FS 1	1.27	2	2	1	2	2	2	2	2	2	1	2	1	2	2	2	0
Blackberry RIM M S1	1.5	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0
Samsung AB463651	0.96	1	1	1	1	1	1	4	1	1	1	4	1	4	1	4	0
Samsung EB555157VA	1.75	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Samsung EBL1A2GBA	1.65	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Samsung EB504465	1.5	4	4	4	3	4	3	4	4	4	4	4	3	4	3	4	2
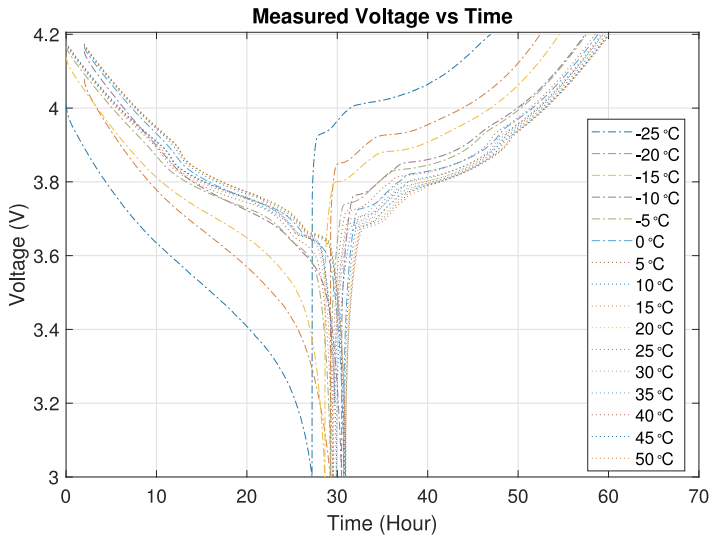
Fig. 1. Sample data from one of the battery cells. The data shown in this plot was collected from Samsung EB575152VA battery (cell number 4) listed in Table 1. The above plot can be reproduced by running 'data_visual.m' from the folder named 'Plot' on Matlab.

tery with serial number "BP 4L" battery where the test temperature was 30 °C and this data is for the cell numbered 4.

The dataset contains two folders one named "Raw" and the other named "Filtered", the latter contains the data after a filter is used to remove the samples where there was no current going through the battery. Figure 1 shows the measured voltage for a "Samsung EB575152VA" battery cell numbered 4 for all temperatures tested. Table 1 summaries the different batteries and temperatures from which the data was collected.

2. Experimental Design, Materials and Methods

Four identical batteries were ordered for each battery model shown in Table 1. For each battery cell shown in Table 1, the following procedure was followed to collect the OCV characterization data. The C-rate of the battery is computed based on the battery capacity shown in Table 1.

1. The battery was fully charged at room temperature (25 °C) at C/30 rate until the terminal voltage reached 4.2 V.
2. The battery is brought to the desired temperature shown in Table 1.
3. The battery is discharged at C/30 rate until the terminal voltage reached 3 V.
4. A 30 seconds rest was given.
5. The battery is charged at C/30 rate until the terminal voltage reached 4.2 V.
6. The {time, voltage, current} data throughout the steps (3) to (5) were recorded by the Arbin tester in an Excel file.

Each excel file was first analyzed for irregularities; it was found that data from some batteries were irregular (this might have happened due to bad connection). These irregular data were removed from further analysis. At initial screening, the charge/discharge capacities of some of the batteries were found to be unusually low; these batteries were considered dead and were

removed from further analysis as well. Table 1 summarizes how many cells remained for each battery type for further analysis and the battery capacity (C_{batt}) of each cell.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.

Acknowledgements

References

[1] M.S. Ahmed, S.A. Raihan, B. Balasingam, A scaling approach for improved state of charge representation in rechargeable batteries, Appl. Energy 267 (2020) 114880.
[2] B. Pattipati, B. Balasingam, G. Avvari, K.R. Pattipati, Y. Bar-Shalom, Open circuit voltage characterization of lithium-ion batteries, J. Power Sources 269 (2014) 317–333.