Application Note AN-BAT-008

Metrohm Autolab DuoCoin Cell Holder with EIS measurements on a commercial battery

The Metrohm Autolab DuoCoin Cell Holder, shown in **Figure 1**, has been developed to perform electrochemical experiments on coin cell batteries.
The DuoCoin Cell Holder can host up to two coin cells, each of 3.2 mm maximum thickness and 24 mm maximum diameter. Typical coin cell sizes which can be hosted in the DuoCoin Cell Holder are CR2016, CR2020, CR2025, CR2032, CR2325, and CR2330. Each connector of the DuoCoin Cell Holder is directly connected to the battery. Therefore, the leads sensing the potential are separated from the leads carrying the current, resulting in a minimized voltage drop due to the impedance of the wires.

Figure 1. The Metrohm Autolab DuoCoin Cell Holder

INTRODUCTION

In this application note, electrochemical impedance spectroscopy (EIS) is used to test a commercial battery. As comparison, the results from the four-electrode configuration are compared with results from two-electrode configuration, in which the RE and CE leads are connected together, as well as the WE and S leads.
The difference in how the leads are connected results in different measured impedance values.

EXPERIMENTAL SETUP

For the EIS measurements, a Metrohm Autolab PGSTAT204 equipped with a FRA32M module is used (**Figure 2**).

The battery used for the experiments is a rechargeable Li-ion, Panasonic VL2330, with 30 mAh of nominal capacity and a nominal voltage of 3 V.

EIS potentiostatic measurements are performed at open circuit potential (OCP), between 10 kHz and 100 mHz, 10 mV amplitude, with a rate of 10 frequencies per decade.

Figure 2. The Metrohm Autolab PGSTAT204, equipped with the FRA32M module.

RESULTS AND DISCUSSION

In **Figure 3** the Nyquist plot of measurement performed with the four-electrode configuration (red dots) are compared with the results obtained with two-electrode configuration (blue and red dots).

Regarding the two-electrode configuration, EIS measurement is performed with connecting the WE and S leads together and the CE and RE leads together, having therefore the RE and S leads closer to the battery (blue dots). Another measurement has been carried out with the leads connections inverted, so connecting S and WE leads together and the RE and CE together, having the WE and CE leads closer to the battery (green dots).

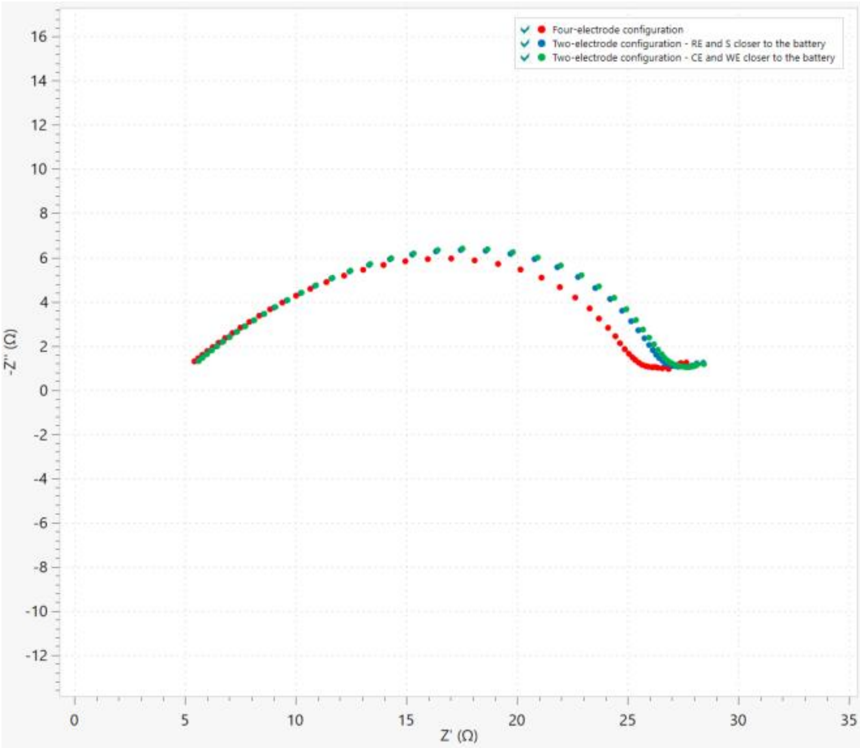


Figure 3. Nyquist plots from EIS measurements performed on the Li-ion battery with four-terminal (red dots) and two-terminal (red dots) sensing configurations.

While there is no appreciable difference between the two-lead configurations, the Nyquist plot corresponding to the four-terminal configuration is shifted towards lower impedance values, with respect to the Nyquist plots resulting from the two-terminal configuration. In **Figure 4**, the magnification at high frequencies of **Figure 3** shows a difference in impedance of approximately 170 mΩ.

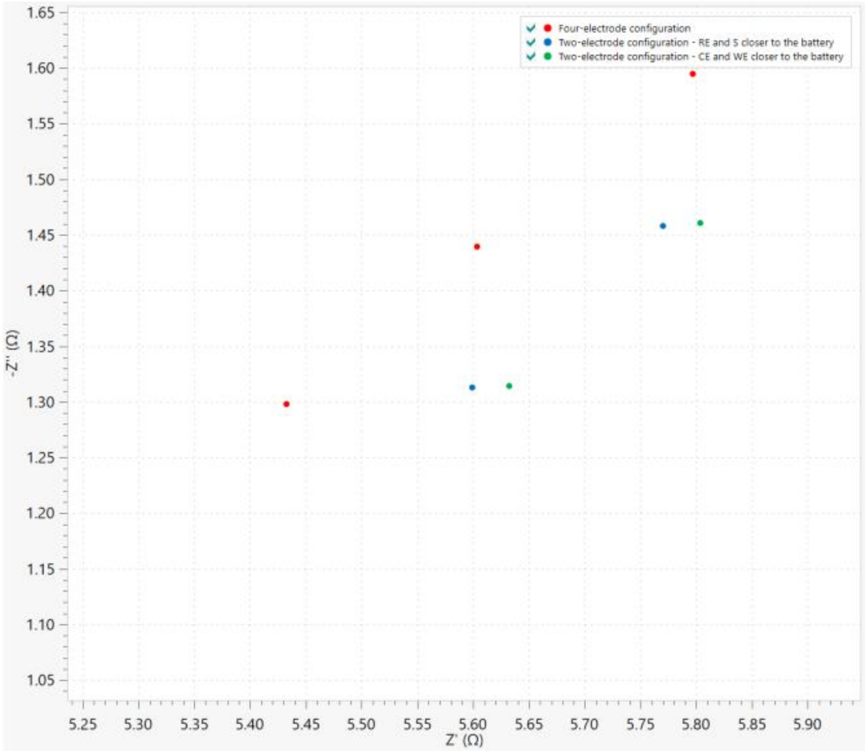


Figure 4. Magnification of Figure 3 at high frequencies.

However, the difference is more evident at low frequencies, as shown in **Figure 5**, where the difference in impedance between the four-terminal and two-terminal configuration at the end of the semicircle is approximately 2 Ω.

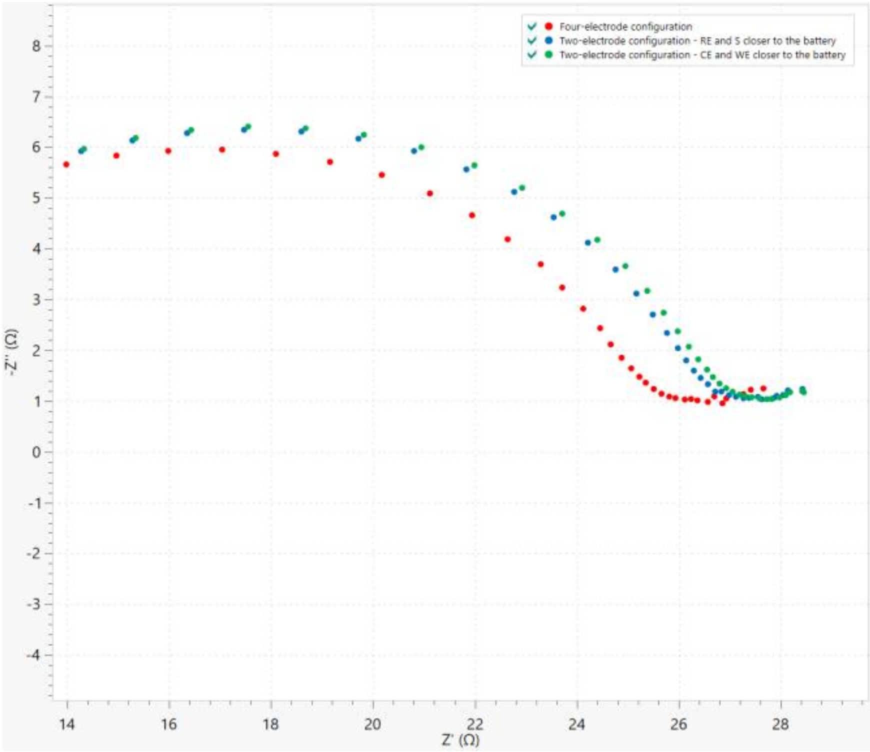


Figure 5. Magnification of Figure 3 at low frequencies.

Finally, it is worth noting that the use of the four-terminal sensing configuration is important only when low-impedance devices are under investigation, like batteries, since the contribution of the wires to the overall impedance is low.

CONCLUSIONS

The DuoCoin Cell Holder is introduced. EIS measurements on a commercial coin cell battery are performed. Differences in impedance between the four-terminal configuration and two-terminal configuration is highlighted, putting in evidence the importance of having a direct four-terminal configuration, when low-impedance DUTs are investigated.

CONTACT

瑞士万通中国
北京市海淀区上地路1号院
1号楼7702
100085 北京

marketing@metrohm.com.cn

Autolab PGSTAT204

PGSTAT204 合了小巧格和模化。器包括基本恒位/恒流,其从 20 V,最大流 400 mA 或 10 A,与 BOOSTER10A 合使用。此恒位可随用附加模行展,例如 FRA32M 化学阻抗(EIS)模。

PGSTAT204 是一款惠的器,可置于室的任何位置。具有模和数字入/出,可控制 Autolab 附件和外部。PGSTAT204 包括内置模分器。与高性能的 NOVA 件用,可用于大多数准化学技。

Autolab PGSTAT302N

高端高流恒位/恒流,具有 30 V 从, 1 MHz,可与我的 FRA32M 模用,化学阻抗而。

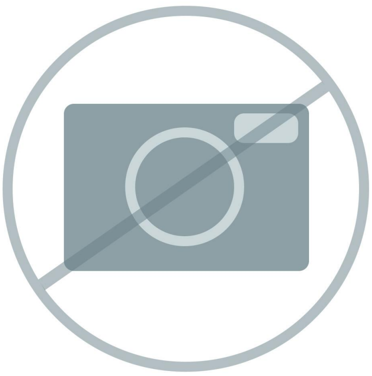
PGSTAT302N 是流行的 PGSTAT30 的后款型。最大流 2 A,借助 BOOSTER20A 流范可展至 20 A,当流范 10 nA 流分辨率 30 fA。

Autolab DuoCoin Cell Holder

Autolab DuoCoin Cell Holder 具有 4 点文金触,可的池研究提供最高精度的量果 。一个通用附件可所有尺寸的准化学池以及小和更大的非准化学池,可以一次理二个化学池。

Autolab DuoCoin Cell Holder 金触和金印刷路板可防止繁忙室中附件的腐和坏。

Autolab DuoCoin Cell Holder 具有可和接件(与 Autolab 恒位/恒流色相),可化装置。Autolab 的重体在 Autolab DuoCoin Cell Holder 底部的硅表面爪上(其可使的装置具有定性)。



NOVA 是通 USB 接口控制所有 Autolab 器的件包。由化学家化学而,集成了超二十余年的用体和最新的 .NET 件技,NOVA 使的 Autolab 恒位/恒流有更性能和活性。

NOVA 提供了以下的独特功能:

- 功能大且活的程序器
- 重要数据一目了然
- 大的数据分析和工具
- 集成化控制外器,如万通 LQH 液体理