THE FARADAY INSTITUTION ReLiB

REUSE & RECYCLING OF LITHIUM ION BATTERIES

RELIB

Reuse and Recycling of Lithium-ion Batteries

07/11/2018

Dr. Pierrot S. Attidekou

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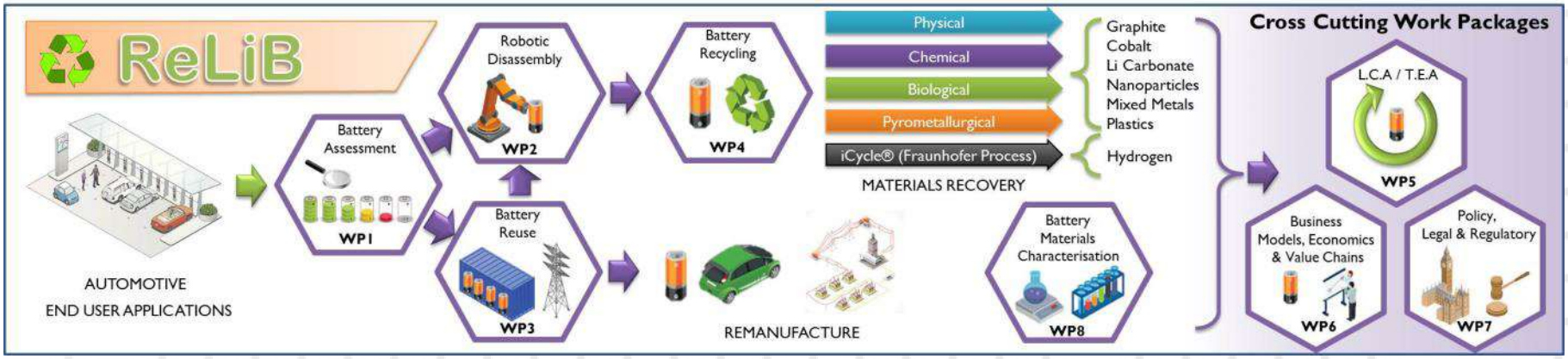
RE-USE & RECYCLING OF LITHIUM ION BATTERIES

To facilitate a circular economy in lithium-ion batteries, tackling the most demanding technical and socio-economic challenges in sensing, gateway testing, sorting, re-use and recycling 100% of a battery pack.

Partner universities:

Birmingham, Cardiff, Edinburgh, Leicester, Liverpool Newcastle, Oxford Brookes, Diamond Light Source

+ 14 industry partners



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WORK STREAM 1

Battery Assessment, Sensing & Sorting and Re-Use

University of Birmingham, Newcastle University, University of Leicester

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Outline

Introduction

Battery assessment / case studied

Further works

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Introduction

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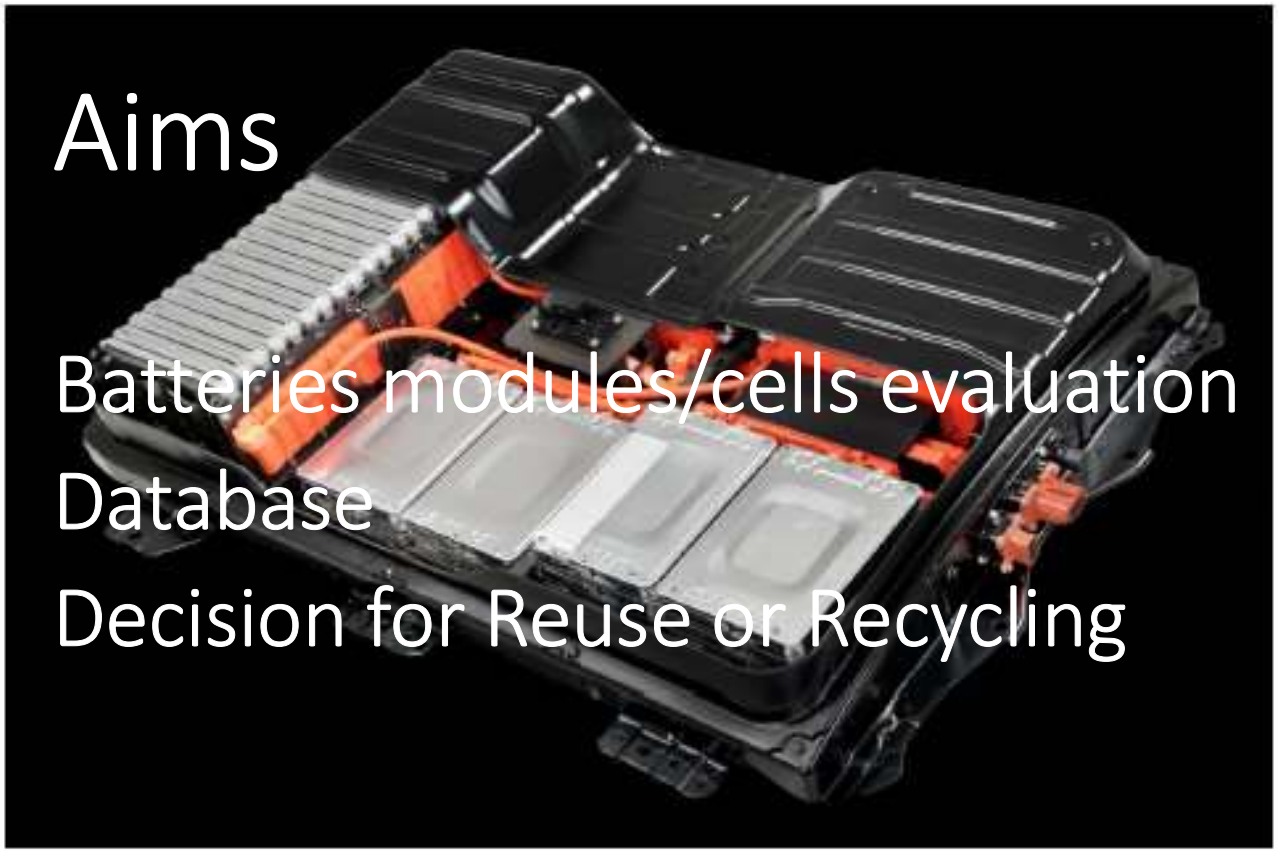

Aims

Batteries modules/cells evaluation

Database

Decision for Reuse or Recycling

Battery Pack

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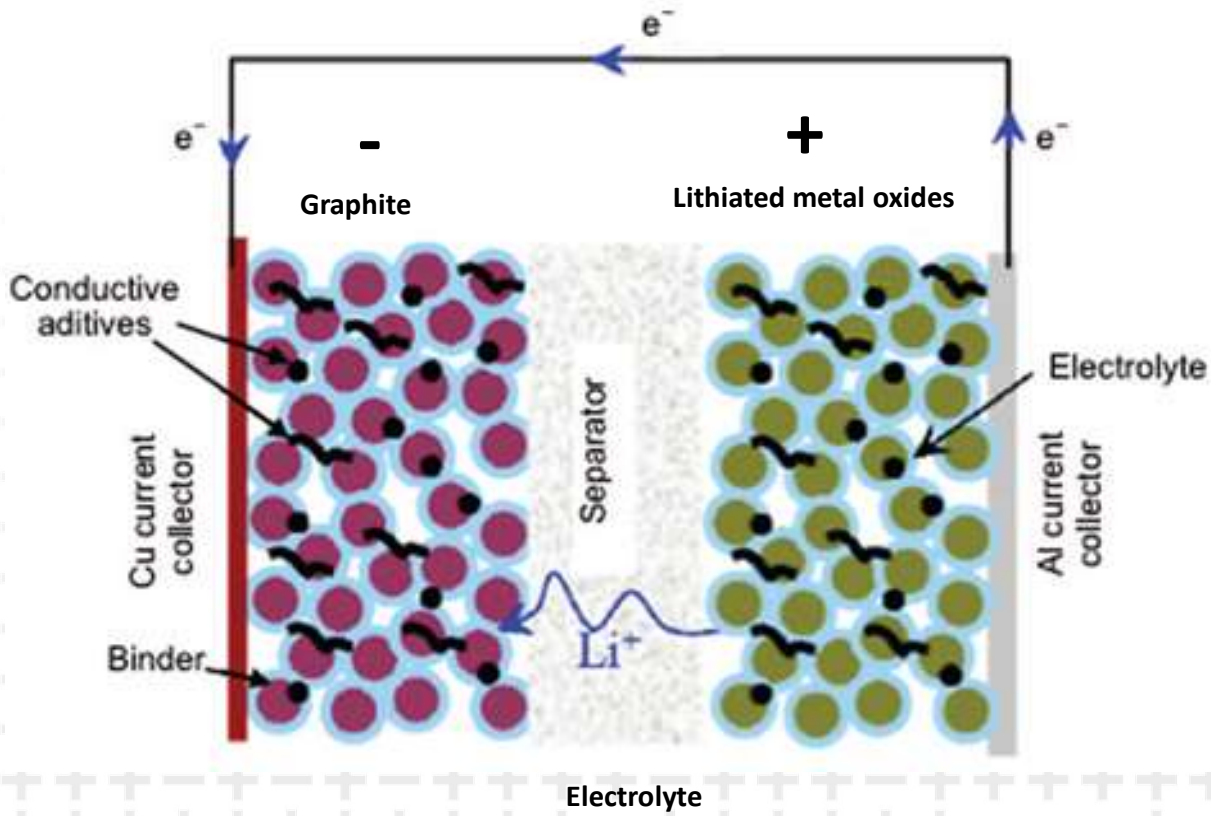
Works by shuttling lithium ions between the two electrodes

Lithiated metal oxides: LCO, LFP, LMO, NMC etc...

Shuttling doesn't continue indefinitely without loosing performance



Major Degradation Process

- Lithium Loss Inventory (LLI)
- Loss of Active Materials (LAM)
- Conduction Loss (CL)
- Lithium Plating

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Parameters

- Capacity monitoring / SoH estimation
- Internal resistance (Rint)
- Relaxation Voltage / Time constant (τ)
- Charge transfer resistance (Rct)
- Etc…

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Battery assessment / case studied

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Parking mode & Driving cycle

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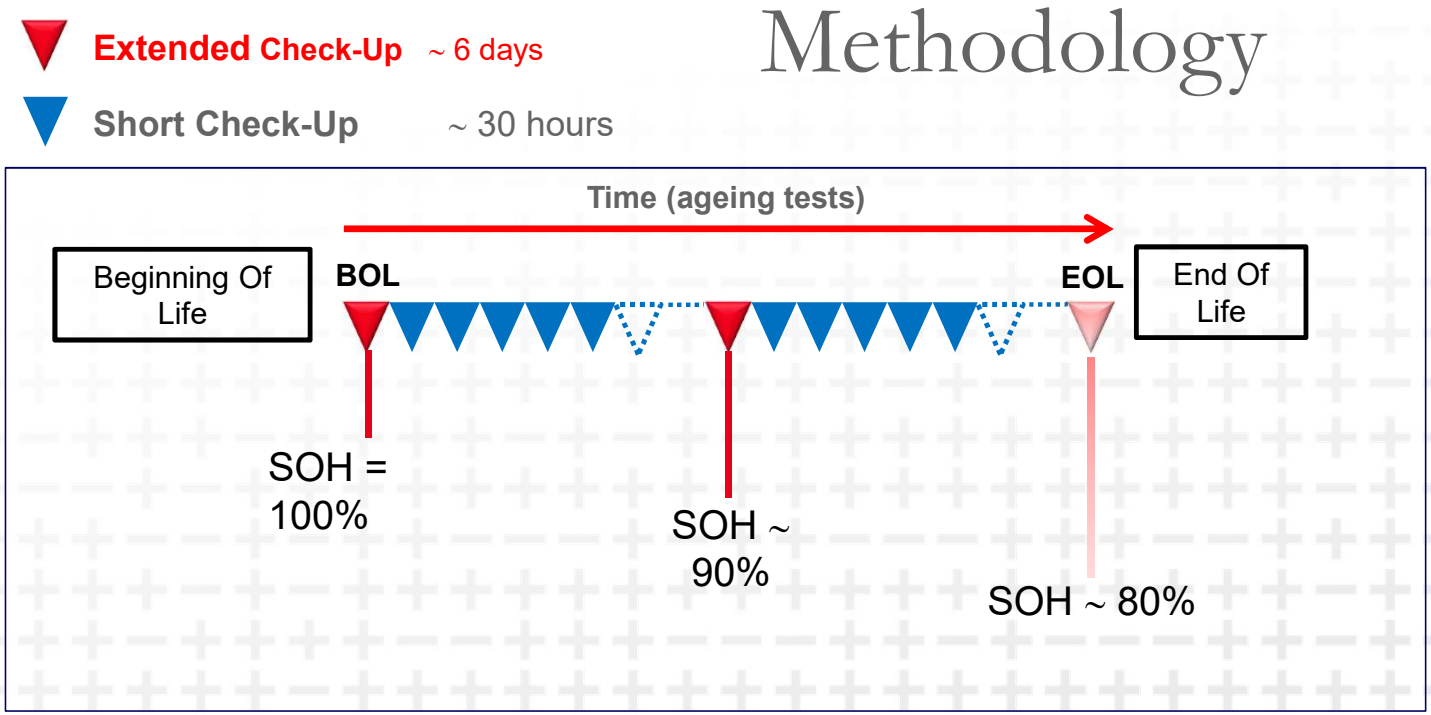
Methodology



- => Capacity/energy (SOH) evolution
- => Resistance evolution (DC and AC) at different SOC

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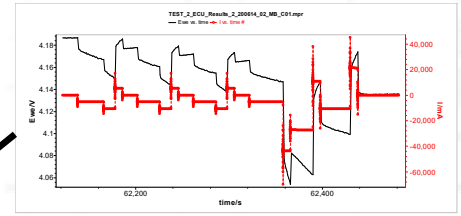
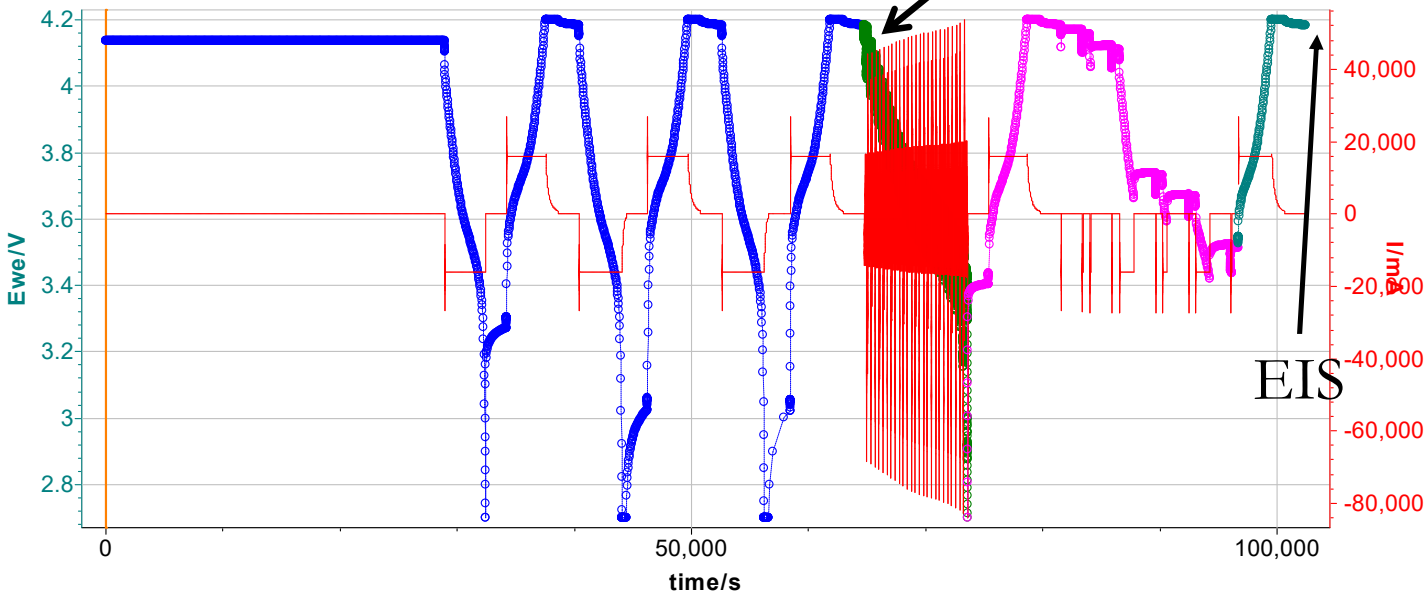
Check - Up @ 25°C

time domain | frequency domain





Cycling @ 1C/ DST/ Pulse Cycling | EIS

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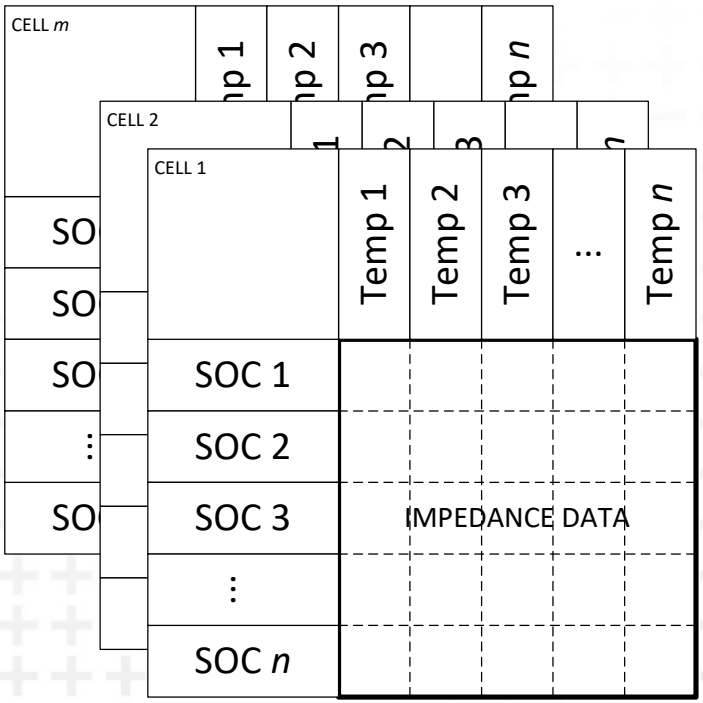
Models Library
Experimental Database
Extract parameters



	SoH	Rint	Tau	Rct	Etc...

	SoH	Rint	Tau	Rct	Etc...

	SoH	Rint	Tau	Rct	Etc...
SoC 1					
SoC 2					
SoC 3					
:					
SoC n					

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Mixed Cycling:

Driven Mode

1 loop = 50 cycles

Parking Mode

72 hours parking

Check up after 200 cycles

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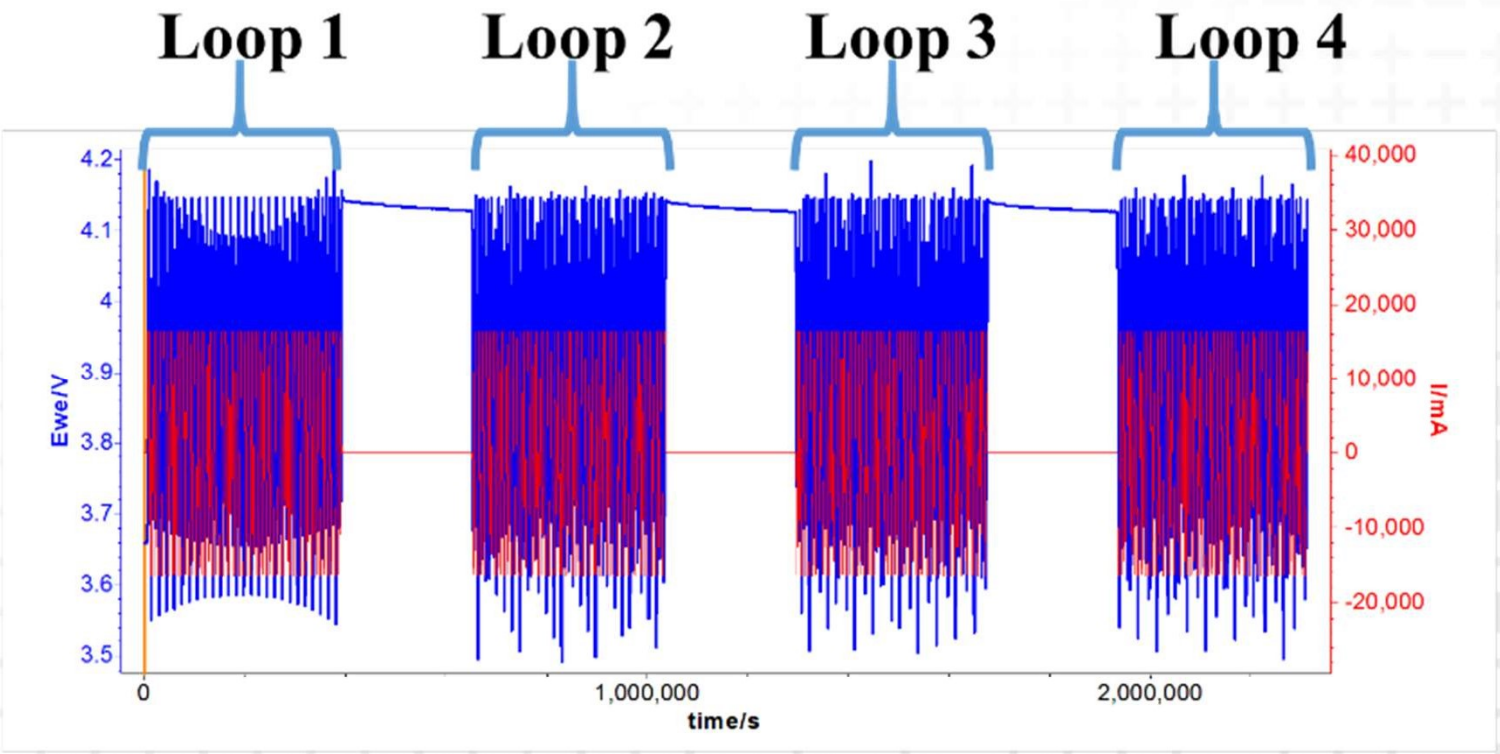

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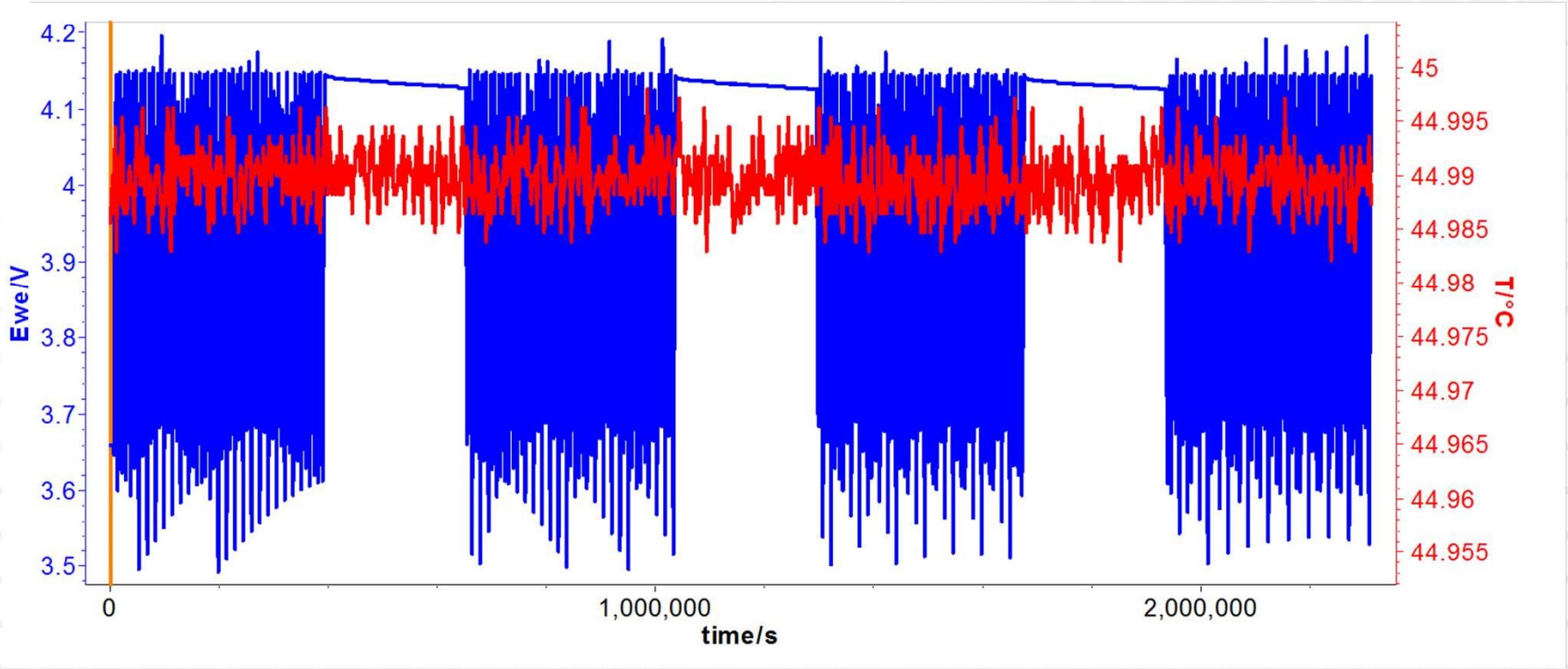

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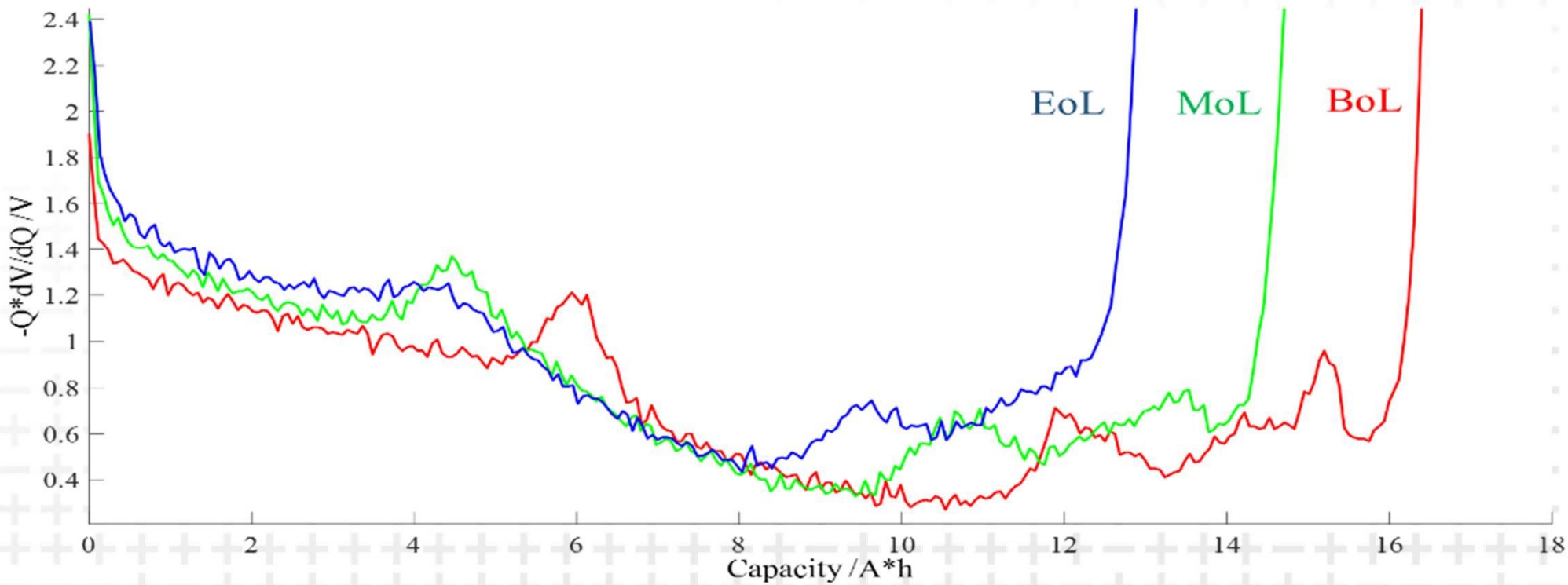
Differential Capacity



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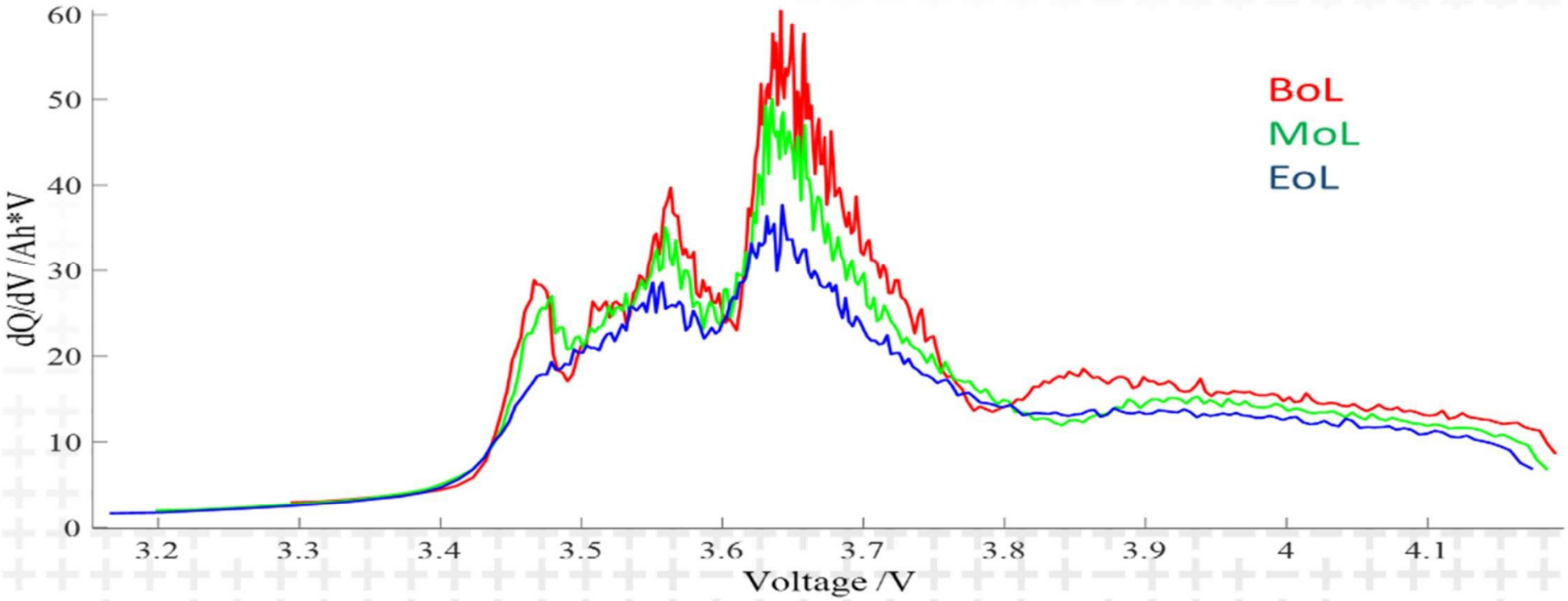
Incremental Capacity



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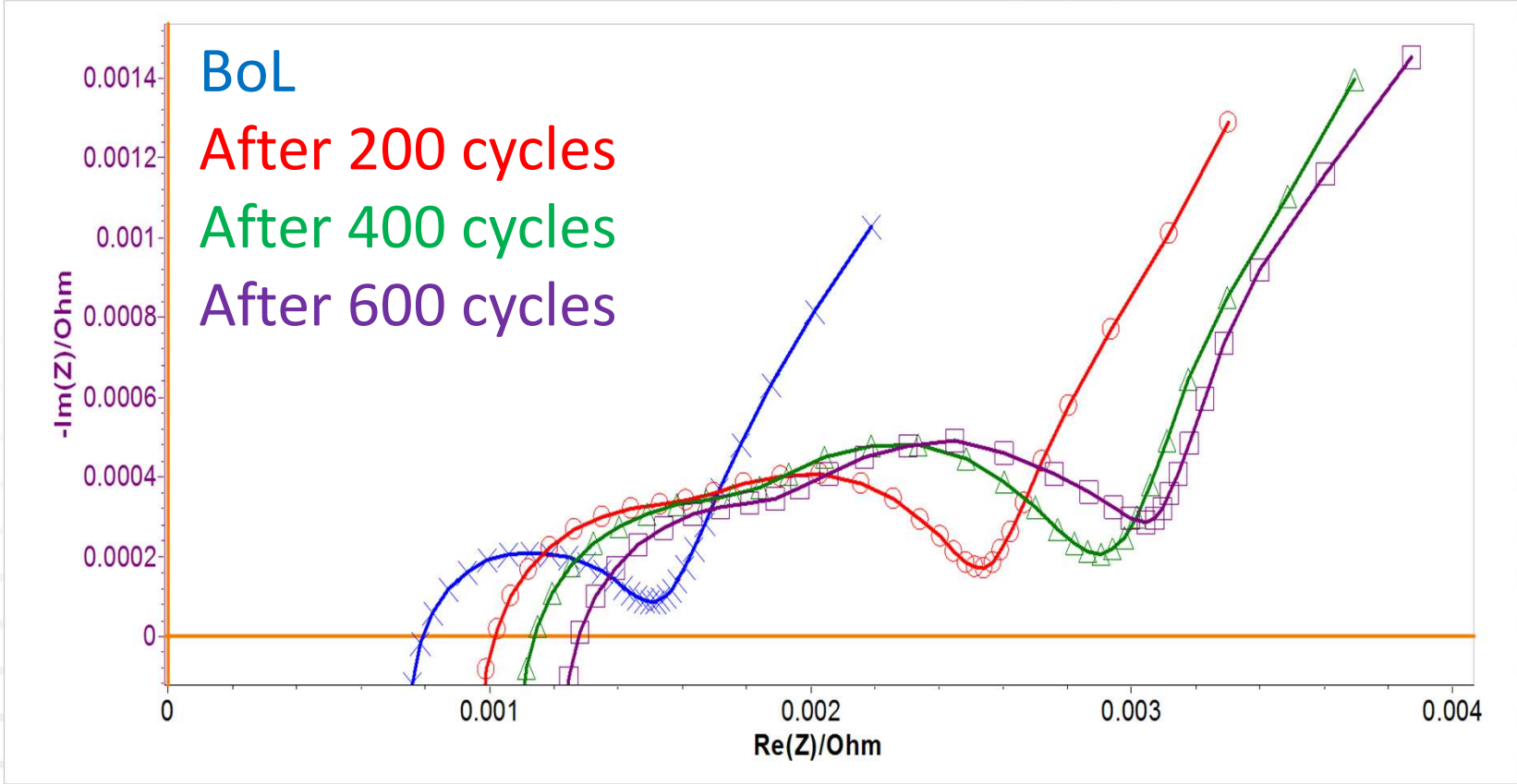
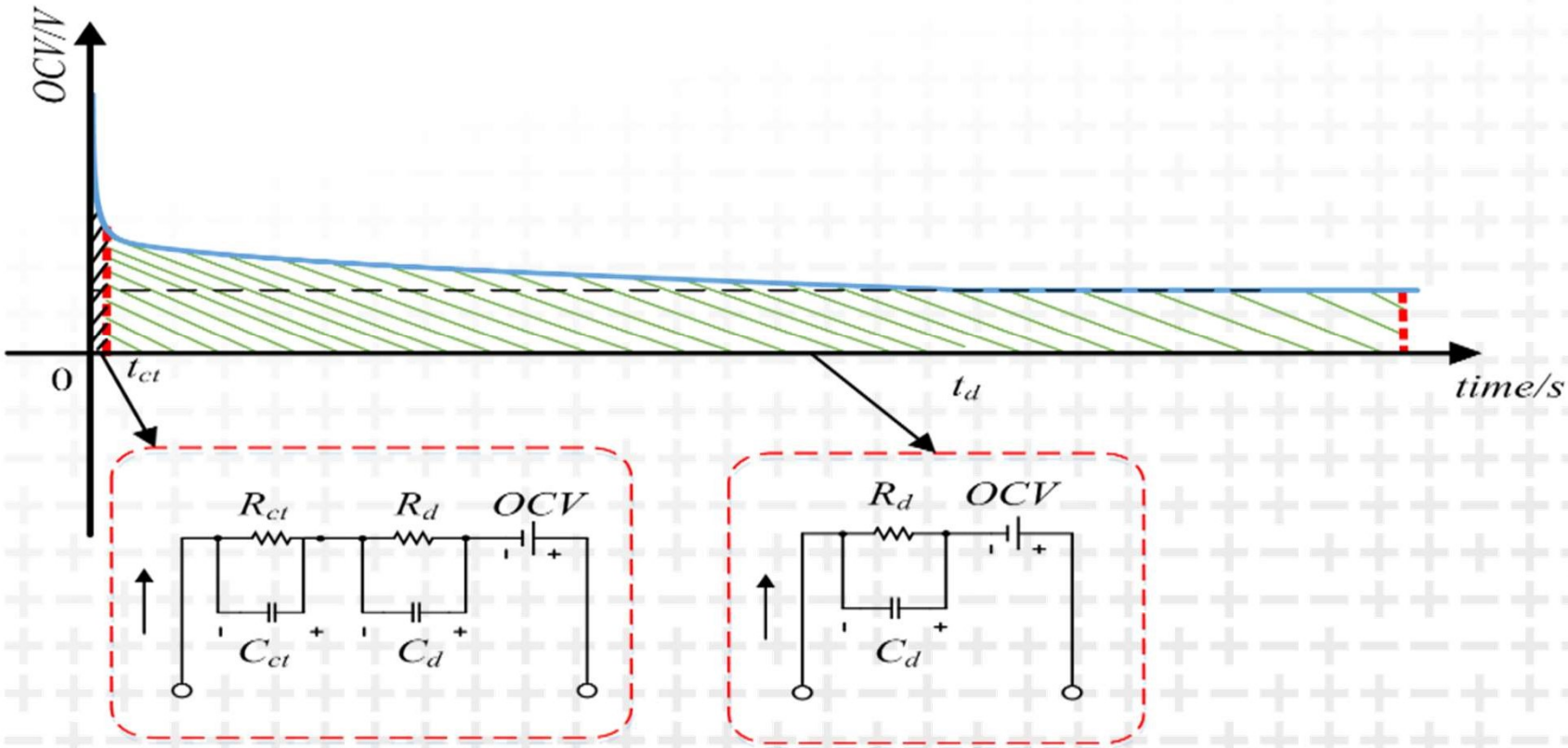
Internal resistance



Time constant



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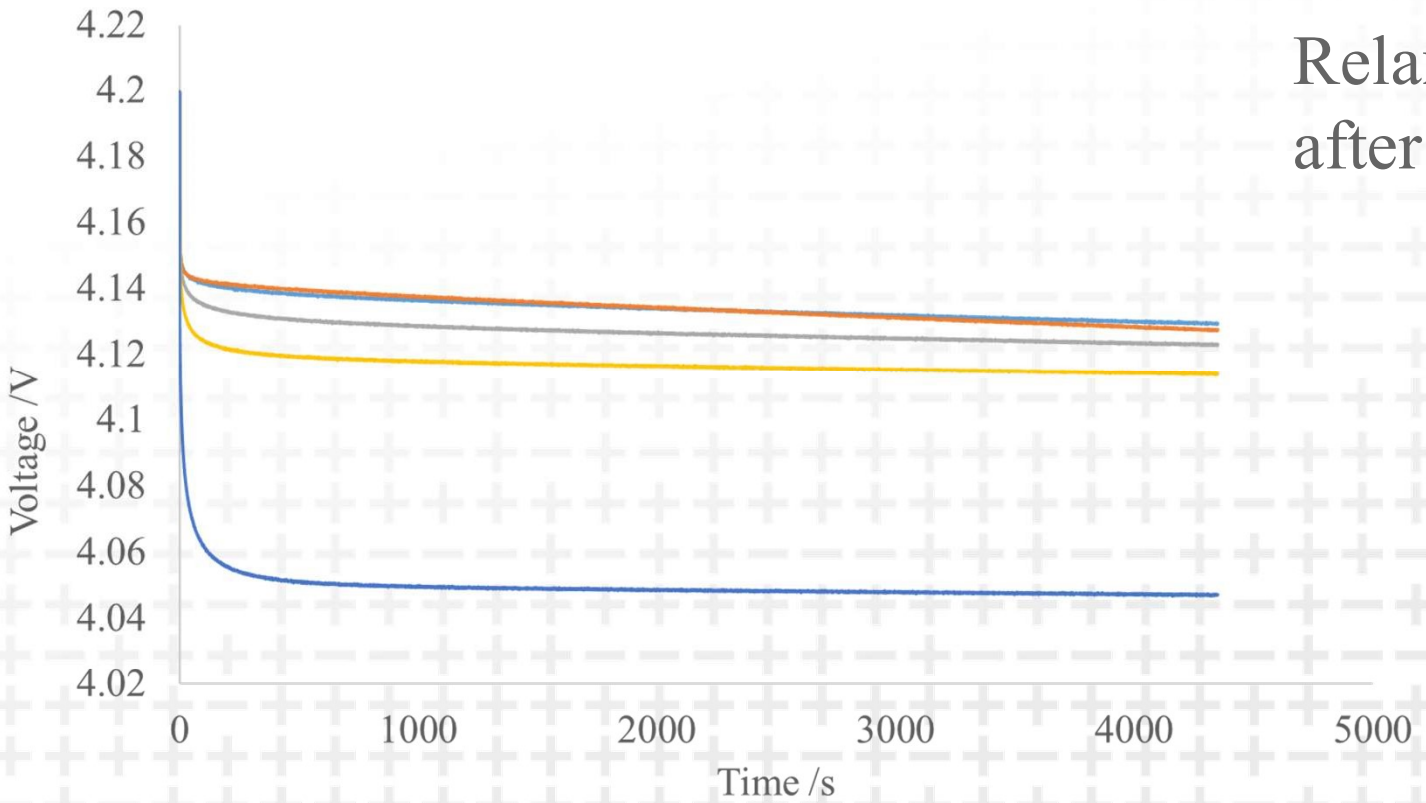

Relaxation curves after:

1st loop

5th loop

9th loop

13th loop

17th loop

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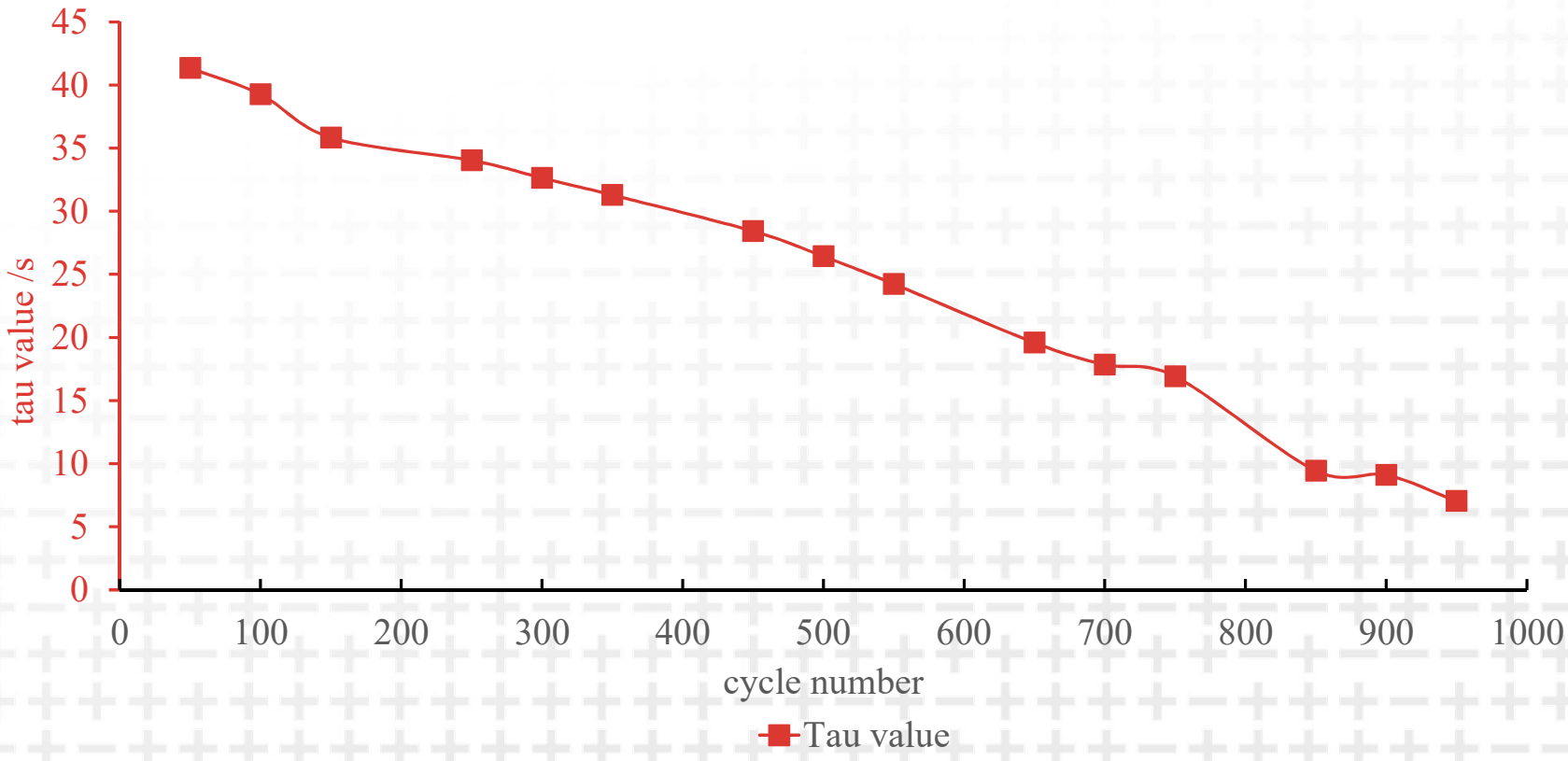
Time constant



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Further work:

Decision making Recycling or Reuse?

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- **Histogram**

- **SoH ≤ 80%**
- **(Rint / $Rint_0$) ≥ 2**
- **Rct ≥ not yet established**
- **Other parameters analysis**
  - *Time domain*
  - *Frequency domain*
- **2nd life investigation** (below 80% SoH)

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Thank you for your attention

Any questions?

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