



Title: Coin Type Lithium ion Rechargeable Battery	Number: PD3535-04J18
Model: <i>Powerdisc</i> 3535	Date: 2005. 05. 16 Rev : 3

PRODUCT SPECIFICATIONS OF COIN TYPE LI-ION RECHARGEABLE BATTERY

MODEL: PD3535

PRESENTED TO: _____

Accepted by : Date:
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Korea PowerCell Inc.

Prepared by : Hyo-Seok Park ()
Approved by : Geun-Chang Chung ()
Date :



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1. Preface

This Product Specification describes the requirements of Coin Type Lithium-ion Rechargeable Battery ("Cell") to be supplied to customer by **Korea PowerCell Inc.**

2. Description

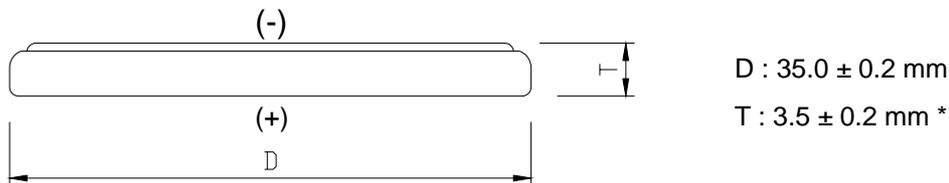
- 2.1 Product **Lithium-ion Rechargeable Battery**
- 2.2 Model (Type) **Powerdisc 3535 (PD3535)**

3. Specifications

Item	Specification	Remark
3.1 Nominal Capacity	320 mAh	0.2C rate, 3.0V cut-off
3.2 Nominal Voltage	3.7 V	From 4.20 V to 3.00V
3.3 Charging Method	CC/CV	Constant Current / Constant Voltage
3.4 Charging Current (Std.)	0.5CA (160mA)	0 ~ 45°C
3.5 Charging Voltage	4.2 ± 0.03 V	
3.6 Charging End Condition	32~10mA	At CV mode
3.7 Charging Time (Std.)	> 3.0 hours	
3.8 Discharge Current (Std.)	0.2CA (64mA)	- 20 ~ 60°C
3.9 Discharge Current (Max)	0.5CA (160mA)	- 20 ~ 60°C
3.10 Discharge Cut-off Voltage	3.0 V	
3.11 Cell Weight	Approx. 10±1g	
3.12 Storage Temperature Range	-20 ~ 35	

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4. Dimensions (unit : mm)



* Swelling of max. 5% over battery life is not included in the specification.

5. Standard Test Conditions

Unless otherwise specified, all tests stated in this Product Specification are conducted at temperature 25 ± 3 and humidity $65 \pm 20\%$ RH.

6. Electrical Characteristics

6.1 Standard Charge and Discharge Conditions

The "Standard Charge" means charging the Cell with initial charge current 160mA (0.5C) and with a constant voltage 4.20V (± 0.03 V) and a cut off current 10mA at 25 for 3.0 hours.

The "Standard Discharge" means discharging the Cell with constant discharge current 64mA (0.2C) and with 3.0V cut-off voltage at 25 .

6.2 Initial Discharge Capacity

The initial capacity measured under the standard test conditions stated in 6.1

Initial Discharge Capacity Typical 320mAh, Minimum 310mAh

6.3 Initial Internal Impedance

Internal resistance measured at 1KHz after Standard Charge.

Initial Internal Impedance 500 m

6.4 Cycle Life

Capacity after 500 cycles, measured under the test conditions stated in 6.1.

Capacity 250 mAh after 500cycles. (Std. Charge/Discharge condition)



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6.5 Temperature Dependence of Discharge Capacity

Relative capacity at each temperature, measured with constant discharge current 64mA (0.2C) with 2.75V cut-off after the Standard Charge shown below.

Charge Temp.	Discharge Temp.			
25	-20	-10	25	60
	>40 %	>70%	100 %	>95%

6.6 Discharge Characteristics on Current Load (C-Rate)

Relative capacity at each load, measured with constant discharge current 0.2C, 0.5C with 3.00V cut-off after Standard Charge shown below.

Charge Current	Discharge Current	
Standard Charge	0.2 CA	0.5 CA
	64 mA	160 mA
	100 %	>90 %

6.7 Storage characteristic

After stored at the following several conditions, the battery is measured at the standard charge and discharge condition stated in 6.1.

Storage condition	Charge state	Capacity retention	Capacity recovery
20 days at 60°C	Shipping charge	-	> 85%
20 days at 60°C	Full charge	> 60%	> 80%
60 days at 60°C	Full charge	> 30%	> 50%
30 days at 60°C, 90%RH	Full charge	> 30%	> 50%
96 hours at 65°C, 90%RH	Full charge	> 80%	> 90%

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7. Safety Test

Test Item	Test Method	Criteria
7.1 High Temperature	Storing a Cell at 90 for 4 hours after charged at 4.2 V	No leakage
7.2 High Temperature and High Humidity	Storing a Cell at 60 (90 % RH) for 1 week after charged at 4.2V.	No leakage
7.3 Thermal Shock Test	Storing a fully charged Cell(4.2V) at 60 for 2hour and at -20 for 2hour (1 cycle). Total 10 cycles with the maximum transition time, 5 mins.	No leakage
7.4 Hot Box Test	A cell is to be heated in a gravity convection oven. The temperature of the oven is to be raised at a rate of 5 ± 2 per minute to a temperature of 130 ± 2 and remain for 30 minutes at the temperature before the test is discontinued.	No explosion, No fire
7.5 Overcharge Test	Charging the Cell up to 250% of its Nominal capacity at 25 for 2.5 hours.	No explosion, No fire
7.6 Impact Test	A test cell is to be placed on a flat surface. The bar of 9.1 kg weight and 15.8 mm diameter is dropped from a height of 610 mm onto the cell.	No explosion, No fire
7.7 Short-Circuit Test	A Cell is to be short-circuited by connecting the positive and negative terminals of the battery with copper wire having a maximum resistance load of 100m .	No fire or no explosion, until it is completely discharged
7.8 Nail Test	A stainless steel nail having a diameter of 4.0 mm is punched through the cell until the nail has passed through the opposite side of the cell.	No explosion, No fire
7.9 Applying Pressure	Giving Pressure on whole surface of a fully charged cell with 7kg _f for 72 hours	No leakage, No weight decrease



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8. Shipment

The Cell shall be shipped in 25% charged state. (Cell voltage range: 3.7 ~ 3.8 V)

*The remaining capacity before charging shall be changed depending on the storage time and conditions.

9. Warranty

The Warranty of battery is one year from the date of shipment. However, even though the problem occurs within this period, PowerCell won't replace a new battery for free as long as the problem is not due to the failure of PowerCell manufacturing process or is due to customer's abuse or misuse.

- PowerCell will not be responsible for trouble occurred by handling outside of the precautions in this specification.
- PowerCell will not be responsible for trouble occurred by matching electric circuit, battery pack and charger.
- PowerCell will be exempt from warrantee any defect cells during assembling after acceptance.

10. Precautions and Safety Instructions

Lithium-Ion rechargeable batteries subject to abusive conditions can cause damage to the battery and/or personal injury. Please read and observe the standard battery precautions below before using utilization.

Note 1. The customer is required to contact PowerCell in advance, if and when the customer needs other applications or operating conditions than those described in this document.

Note 2. PowerCell will take no responsibility for any accident when the cell is used under other conditions than those described in this Document.

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10.1 Precautions and Safety Instructions:

- a. Do not expose the battery to extreme heat or flame.
- b. Do not short circuit, over-charge or over-discharge the battery.
- c. Do not subject the battery to strong mechanical shocks.
- d. Do not immerse the battery in water or sea water, or get it wet..
- e. Do not reverse the polarity of the battery for any reason.
- f. Do not disassemble or modify the battery.
- g. Do not remove charge/discharge protection circuitry.
- h. Do not handle or store with metallic like necklaces, coins or hairpins, etc.
- i. Do not use the battery with conspicuous damage or deformation.
- j. Do not connect battery to the plug socket or car-cigarette-plug.
- k. Do not make the direct soldering onto a battery. Weld spot welding lead plate onto a battery.
- l. Do not touch a leaked battery directly.
- m. Do not use for other equipment.
- n. Do not use Lithium-ion battery in mixture.
- o. Do not use or leave the battery under the blazing sun (or in heated car by sunshine).
- p. Keep battery away from children.
- q. Do use the specified charger and observe charging requirement.
- r. Do not drive a nail into the battery, strike it by hammer or tread it.
- s. Do not give battery impact or fling it.

10.2 Battery Operation Instruction:**A. Charging**

- a. Charge the battery in a temperature range of 0°C to + 45°C.
- b. Charge the battery at a constant current of 0.5C until 4.20±0.03V per cell is attained. Charge rates greater than 0.5C are NOT recommended. (C : Rated Capacity of Battery)
- c. Maintain charge voltage at 4.20V per cell for 3.0 hours (recommended for maximum capacity).

* Use a constant current, constant voltage (CC/CV) lithium-ion (Li+) battery charge controller.

* Do not continue to charge battery over specified time.

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B. Discharging

- a. Recommended cut-off voltage to 3.0V. Recommended maximum discharge rate is 0.5C at constant current.
- b. For maximum performance, discharge the battery in a temperature range of -20°C to $+45^{\circ}\text{C}$.

C. Protection Circuit

A protection circuit is provided for protecting the battery against damage and/or performance deterioration.

Over charge voltage protection	: 4.275 ± 0.025 V
Over discharge voltage protection	: 2.30 ± 0.058 V
Over current protection	: 2.90 ± 0.5 A
Current consumption(leakage current)	: I 6.0 μA

D. Storage Recommendations

- a. Storage Temperature and Humidity
 - Storage the battery at temperature range of $-20 \sim +35^{\circ}\text{C}$, low humidity and no corrosive gas atmosphere.
 - No condensation on the battery
- b. Long Period Storage
 - In case of long period storage (more than 3 months), storage the battery at temperature range of $-10 \sim +20^{\circ}\text{C}$, low humidity, no corrosive gas atmosphere.
 - No condensation on the battery

11. Consultation

As to the obscenity, contact the following.

PowerCell Korea Inc. Sales & Marketing Division

sales@powercellkorea.com

Tel : +82-42-864-0255

Fax : +82-42-864-4342

12. Requirement for Safety Assurance

For the sake of safety assurance, please discuss the equipment design, its system and protection circuit of Lithium-ion battery with PowerCell in advance.

And consult about the high rate current, rapid charge and special application in the same way.

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Appendix. 1

A. PCM Specifications (H-PCM)

Item	Specification	Remark
1. Protection IC	R5426D106EA	RICOH
2. Over charge protection voltage	4.275±0.025V	
3. Over discharge protection voltage	2.30±0.058V	
4. Over current protection current	2.90±0.5A	
5. Leakage current	< 6uA	
6. PCB type	Hard PCB	

B. Drawing of Cell with PCM

SW	ZON	REVISIONS	REV NO	CHG DATE	CHECK	APPR

	DWG NO	DWG NAME	MTL	NOTE
①	SMP-050501	PD 3535	Ni coated SUS 316L	
②	SMP-050502	H-PCM	-	
③	SMP-050503	Kyocera 8005	-	
④	SMP-050504	Insulation tube	PET	t=0.1±0.03
⑤	SMP-050505	Insulation tape	-	
⑥	SMP-050506	Fixing tape	-	
⑦	SMP-050507	Insulation tape(+)		∅32 , 40um
⑧	SMP-050508	Insulation tape(-)		∅30 , 80um
⑨				
⑩				

Bare cell diameter	35.05mm
Max cell thickness	3.8mm
Max height	4.1mm

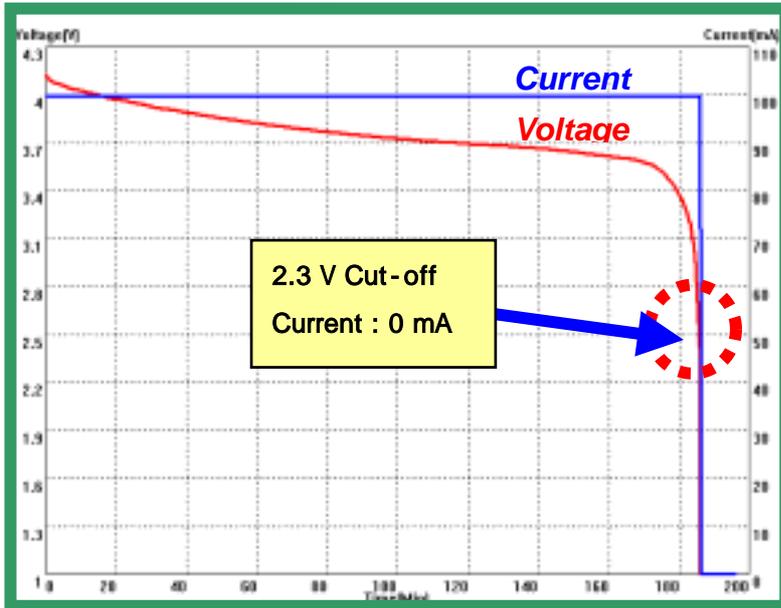
Notes:

- 1) All Dimensions in mm
- 2) Battery KPC PD 3535
- 3) Tab material Stainless steel - Ni plating
- 4) Spot weld Tab to battery
- 5) Welding position can be changed slightly
- 6) PCM's dimension & welding position can be changed slightly
- 6) *Insulation tube
- Color: Deep green

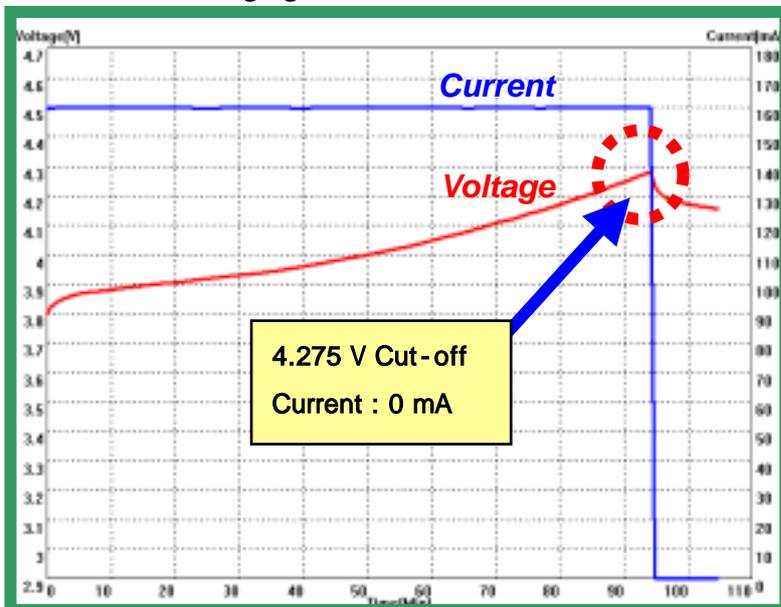
TITLE	PD 3535 with PCM	REV. NO	3	Q'TY/SET	1
MODEL NAME	PD 3535	MATERIAL	SUS 316L / Ni		
ASSY NAME		Tolerance	±0.5		PART NO
DRAWN BY	Y.H.Jung	CHECKED BY	T.H. Jeon	APPROVED BY	SCALE 1/1
	14. May. 2005		16. May. 2005		UNIT MM
					DRAWING NO PD 3535-SMP-101
					PAGE 1 OF 1

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C. Over-discharging Protection



D. Over-charging Protection





Title: Coin Type Lithium ion Rechargeable Battery	Number: PD3535-04J18
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E. Inspection Result

Item No.	Protection Function							
	Over Voltage Protection		Under Voltage Protection		Over Current Protection		Current Consumption	Short protection Delay time
	Protection(V)	Release(V)	Protection(V)	Release(V)	Charge(A)	Dis-Charge(A)	Normal(μA)	
	Delay Time(sec)		Delay Time(sec)		Delay Time(sec)	Delay Time(sec)	Powerdown(μA)	
1	4.283	Auto Release	2.291	Auto Release	2.98	2.84	3.21	
	0.938		20.42		7.63	5.95	0.00	
2	4.287	Auto Release	2.295	Auto Release	3.02	2.82	3.35	0.324
	0.968		20.11		7.78	6.07	0.00	
3	4.291	Auto Release	2.291	Auto Release	2.96	2.86	3.23	0.312
	0.922		19.23		7.42	5.80	0.00	
4	4.283	Auto Release	2.295	Auto Release	2.98	2.84	3.39	0.316
	0.960		19.68		7.72	6.04	0.00	
5	4.277	Auto Release	2.297	Auto Release	2.94	2.80	3.32	0.288
	0.903		19.01		7.32	5.71	0.00	
6	4.285	Auto Release	2.293	Auto Release	2.98	2.84	3.49	0.296
	0.942		20.78		7.78	6.08	0.00	
7	4.287	Auto Release	2.291	Auto Release	2.96	2.82	3.19	0.304
	0.935		19.23		7.57	5.92	0.00	
8	4.283	Auto Release	2.293	Auto Release	3.02	2.86	3.37	0.312
	0.922		19.29		7.42	5.83	0.00	
9	4.277	Auto Release	2.293	Auto Release	2.98	2.82	3.30	0.320
	0.975		20.11		7.84	6.10	0.00	
10	4.283	Auto Release	2.291	Auto Release	2.94	2.84	3.11	0.316
	0.944		20.48		7.63	6.01	0.00	
Spec.	4.275±0.025 V	@Remove charger &Discharge current	2.300±0.058 V	@Remove charger &Discharge current	3.0±0.5A	2.9±0.5A	Max. 6.0 uA	Max. 1.0ms
	0.6~1.4 sec		10~30msec		5~15 msec	4~16 msec	Max. 0.1 uA	
Max	4.291	Auto Release	2.297	Auto Release	3.02	2.86	3.49	0.340
	0.975		20.78		7.84	6.10	0.00	
Min	4.277	Auto Release	2.291	Auto Release	2.94	2.80	3.11	0.288
	0.903		19.01		7.32	5.71	0.00	
Aver. (/X)	4.283	Auto Release	2.293	Auto Release	2.97	2.84	3.30	0.313
	0.938		19.73		7.59	5.94	0.00	

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Lithium-ion
Rechargeable
Batteries

Technical Data Sheet
PD3535

www.powercellkorea.com

Dec, 2004
Korea PowerCell Inc.

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Appendix. Capacity vs. OCV Graph

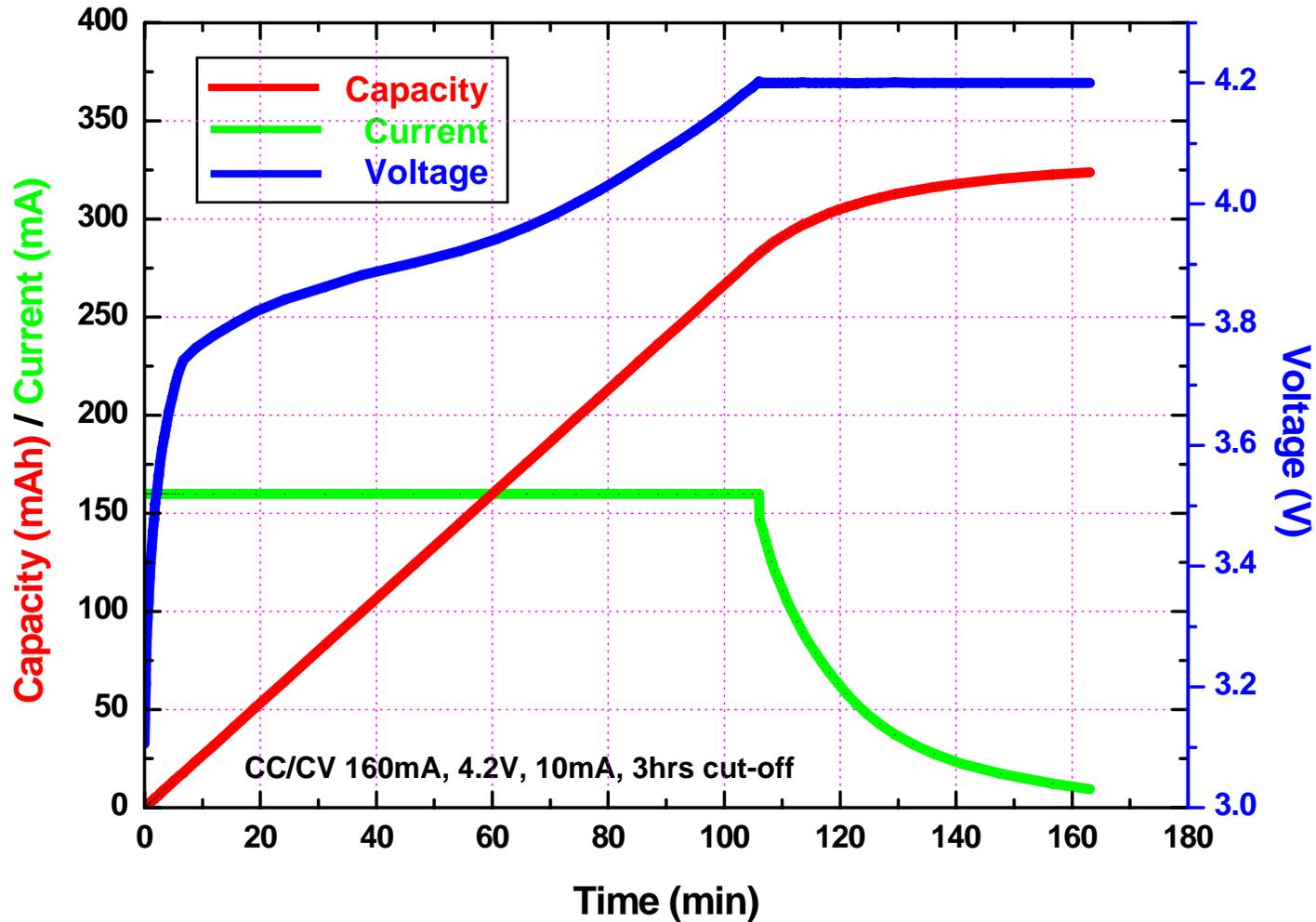
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1. Specification

Model		PD 3535
Nominal Capacity		320 mAh (0.2C, 3.0V Cut-off)
Nominal Voltage		3.7 V
Dimension	Thickness	3.5 ± 0.2 mm (center)
	Diameter	35.0 ± 0.2 mm
Charge Method		CC-CV
Charge Voltage		4.2 V
Charge Current		* Standard 160 mA, (End - Current : 30~9 mA)
Discharge Current		* Standard 60 mA, Max. 160 mA
Discharge end voltage		3.0 V
Discharge Temperature		- 20°C ~ + 60°C
Internal Impedance		Max. 500 mohm
Weight		approx 10g (± 1g)

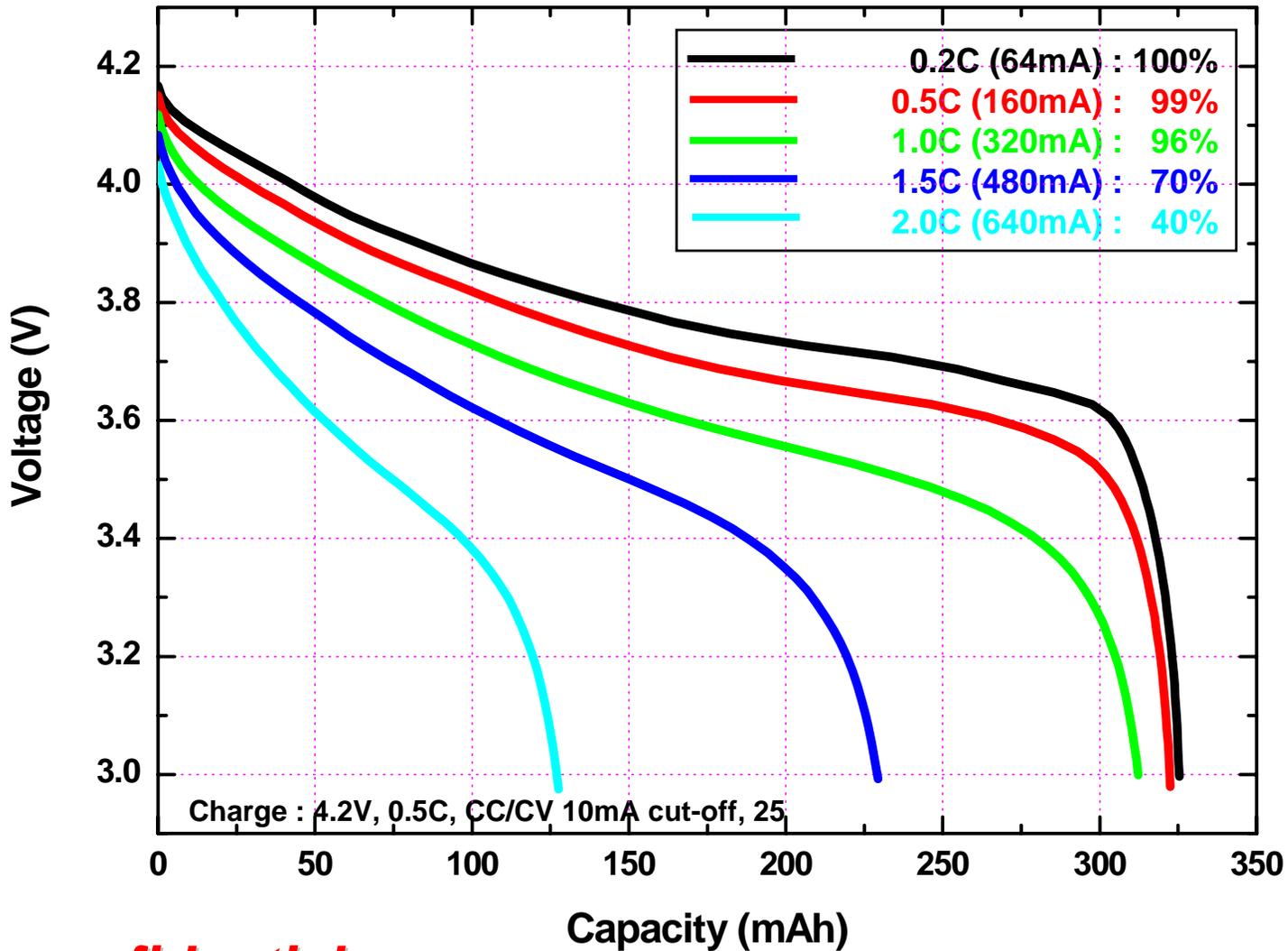
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2. Charge Characteristics – 0.5C at 25



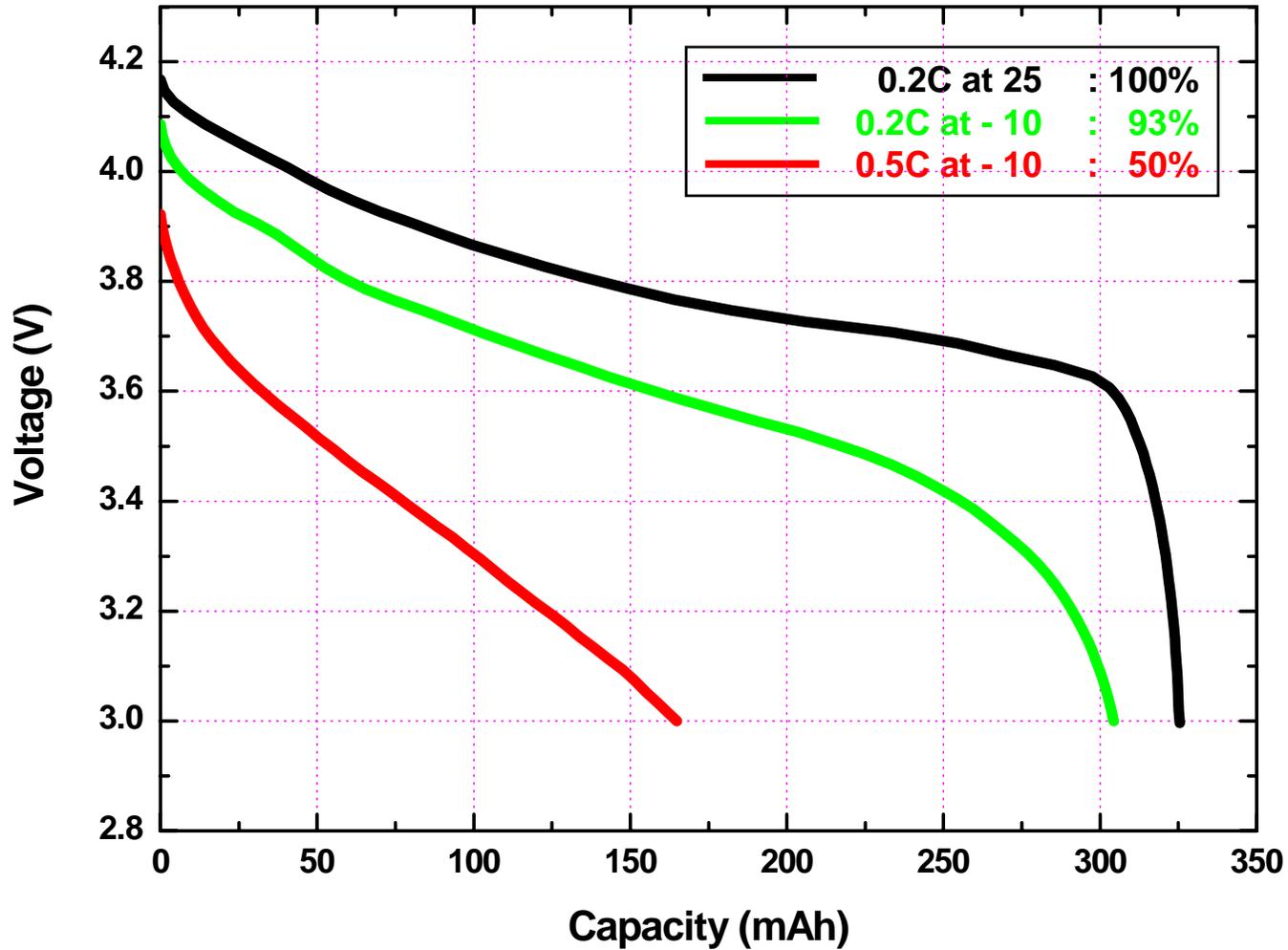
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3.1. Discharge Characteristics at 25



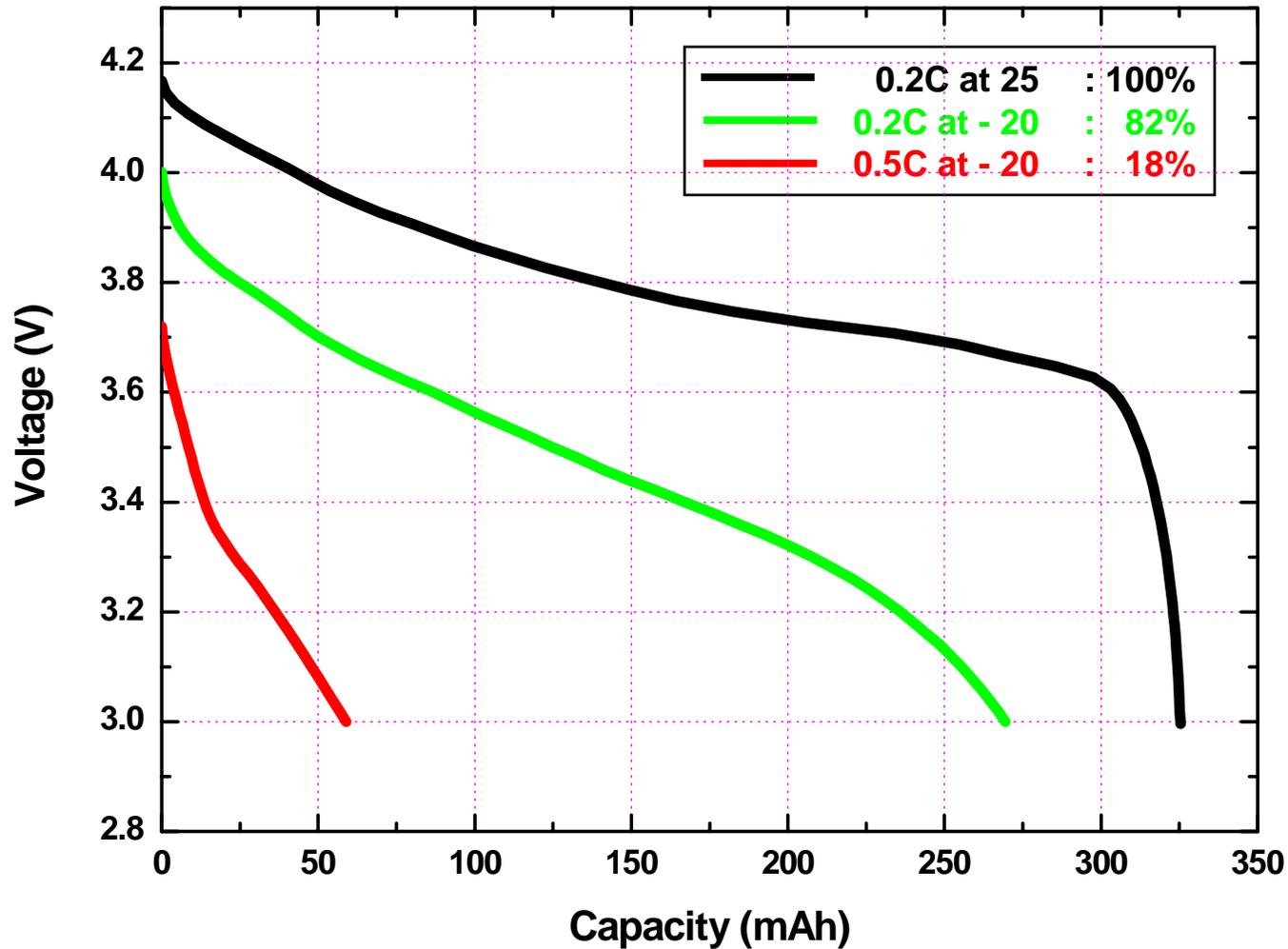
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3.2. Discharge Characteristics at -10



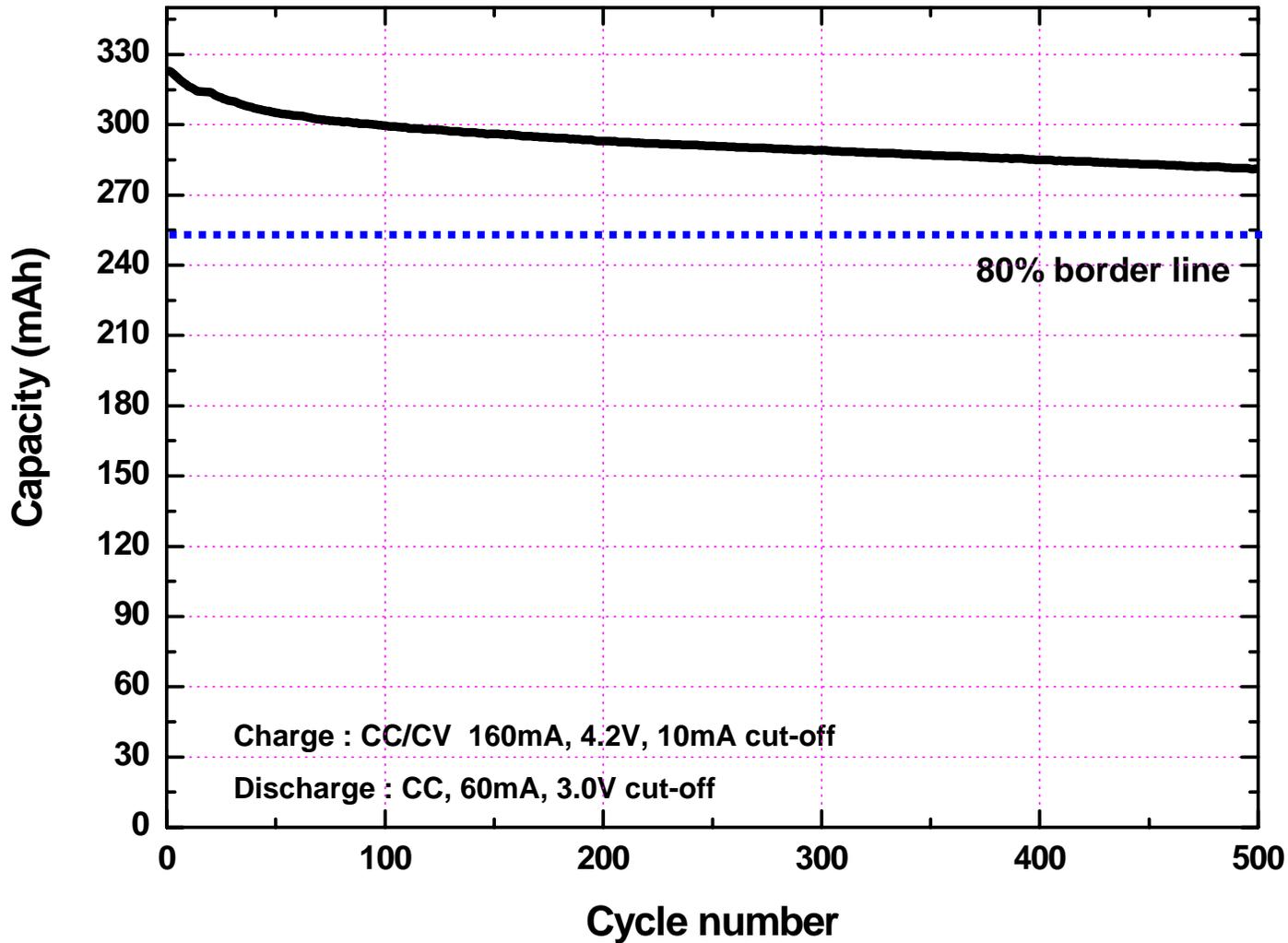
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3.3. Discharge Characteristics at -20



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4. Cycle life – 0.5C charge/ 0.2C discharge



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5. High temperature storage Test (90 , 4hrs)

** Average of 10 samples.*

	Before storage	After storage	Δ
Weight, g	10.604	10.603	0.01%
Thickness, mm (at 90°C)	3.64	3.75	2.94%
Thickness, mm (at RT)	3.64	3.69	1.46%
Residual capacity, mAh	321	284	89%
Recovery capacity, mAh	321	301	94%

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6-1. Humidity test (60 , 90% RH, 1 week)

** Average of 10 samples.*

	Before storage	After storage	Δ
Weight, g	10.660	10.656	0.04%
Thickness, mm (at RT)	3.64	3.67	0.90%
Residual capacity, mAh	322	280	87%
Recovery capacity, mAh	322	303	94%

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6-2. Humidity test (65 , 90% RH, 96 hrs)

** Average of 10 samples.*

	Before storage	After storage	Δ
Weight, g	10.602	10.599	0.03%
Thickness, mm (at RT)	3.64	3.67	0.85%
Residual capacity, mAh	322	283	88%
Recovery capacity, mAh	322	306	95%

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Korea PowerCell Inc.

7. Thermal shock test (-40 / 60 , 10 cycles)

** Average of 10 samples.*

	Before storage	After storage	Δ
Weight, g	10.622	10.621	0.01%
Thickness, mm (at RT)	3.64	3.68	1.07%
Residual capacity, mAh	321	308	96%
Recovery capacity, mAh	321	314	98%

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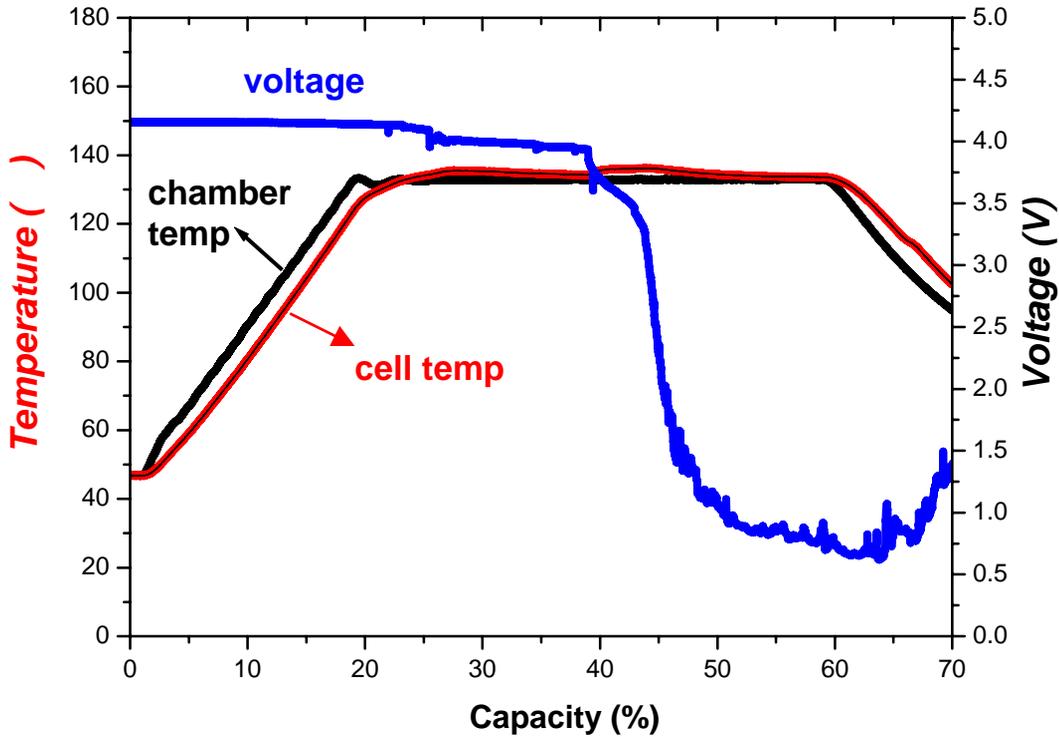
8. Satefy test

Test	comment
Hot box test (130 , 30min)	NF, NE, NV
Nail test (4.0mm nail)	NF, NE, NV
Short circuit test	NF, NE, NV
Overcharge test (1.5C, 250% charge)	NF, NE, Vent

** NF= no fire, NE= no explosion, NV=no vent*

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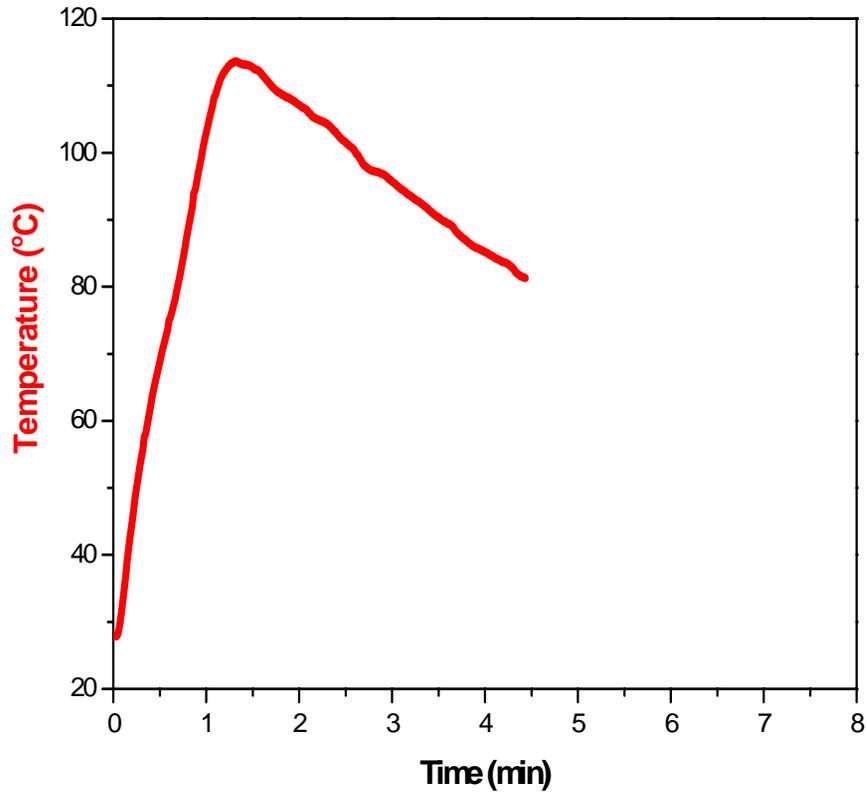
8-1. Hot-Box Test (130 , 30 min)



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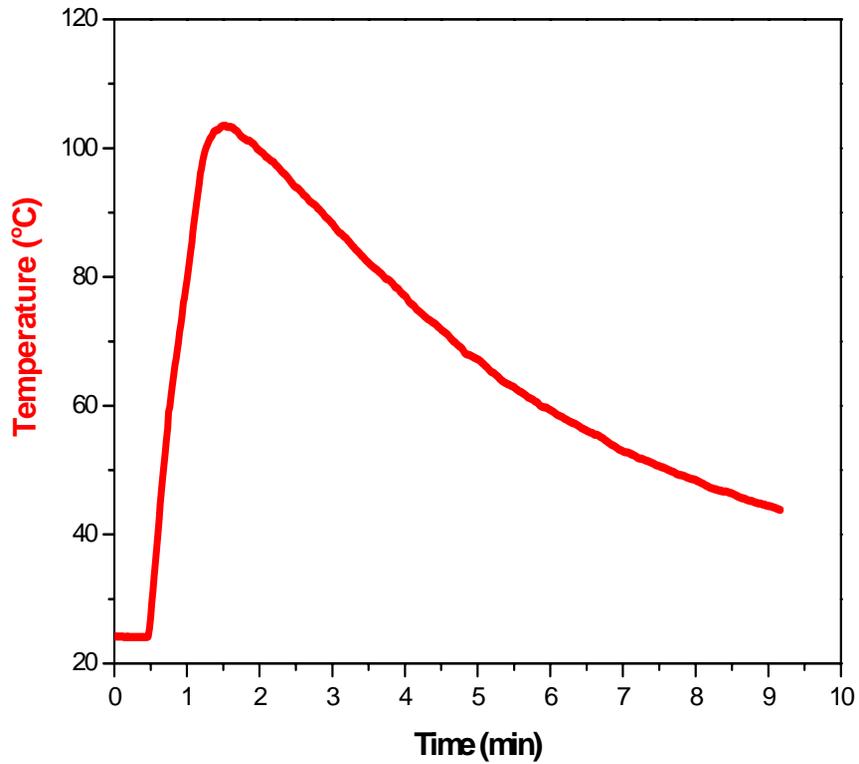
8-2. Nail Penetration Test



<after test>

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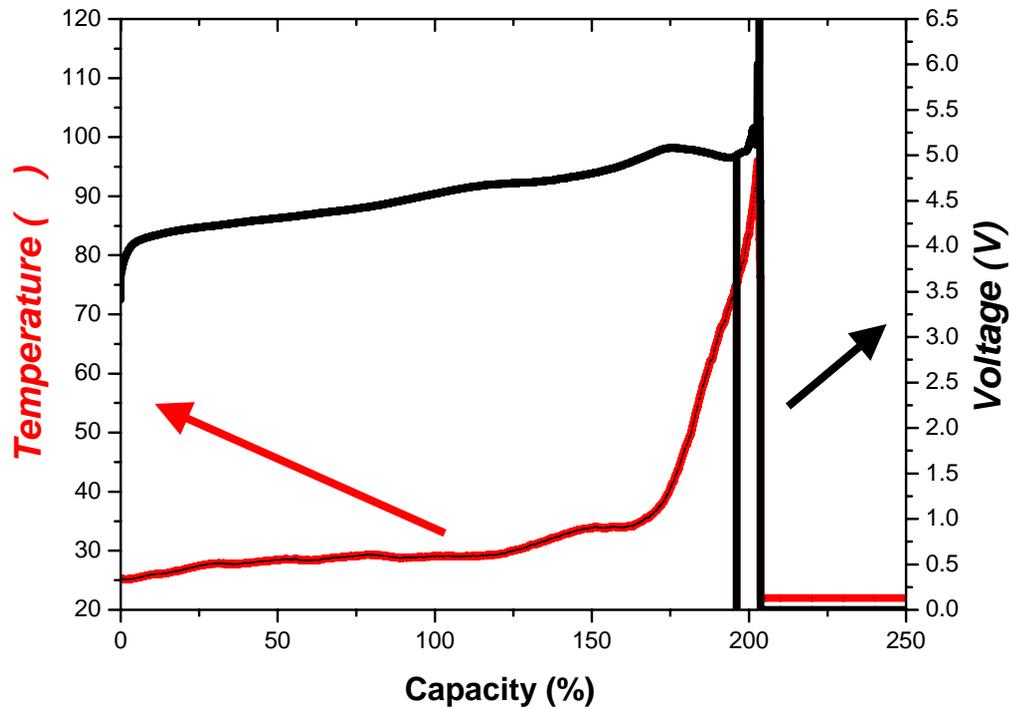
8-3. Short circuit Test



<after test>

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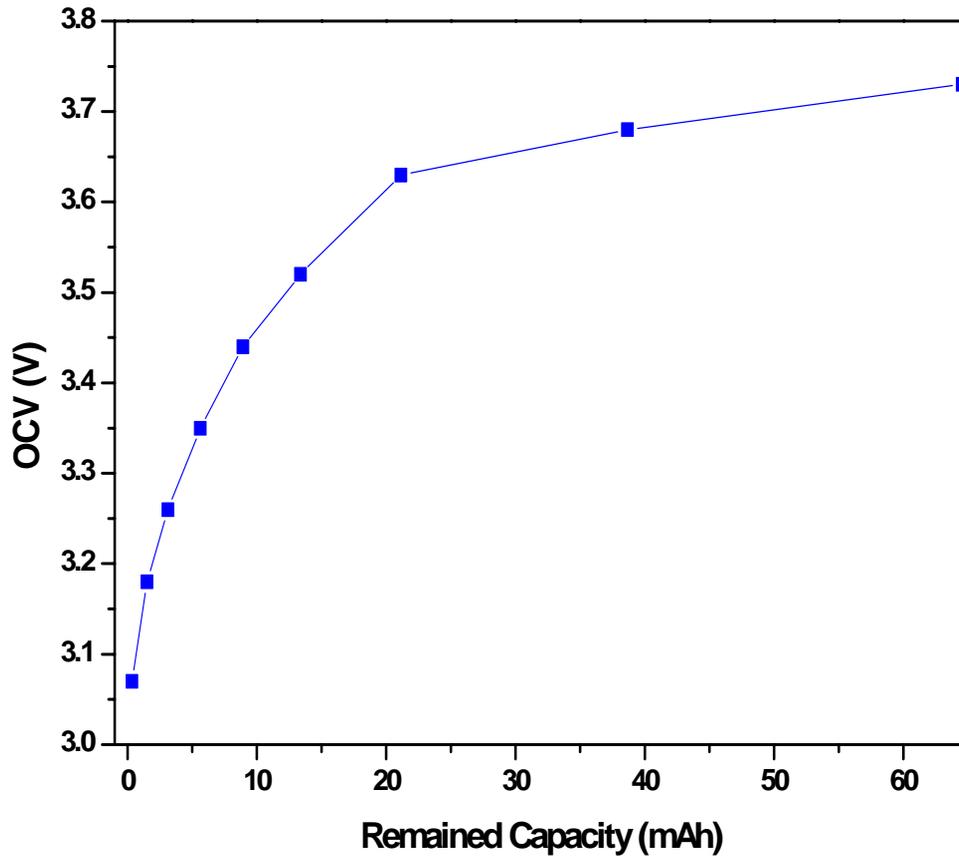
8-4. Overcharge test (1.5C continuous overcharge)



<after test>

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Appendix. Capacity vs. OCV



Remained Capacity	OCV
(mAh)	(V)
64.55	3.73
38.65	3.68
21.12	3.63
13.39	3.52
8.92	3.44
5.63	3.35
3.13	3.26
1.50	3.18
0.34	3.07

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