LG 화학 Lithium Ion Battery 개발 현황

1998년 전지 기술 Symposium

주최 : 한국 전기화학회, 한국 공업화학회, 전지조합

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1998 12.4 (금)

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LG Chemical / Research Park

Battery Research Center

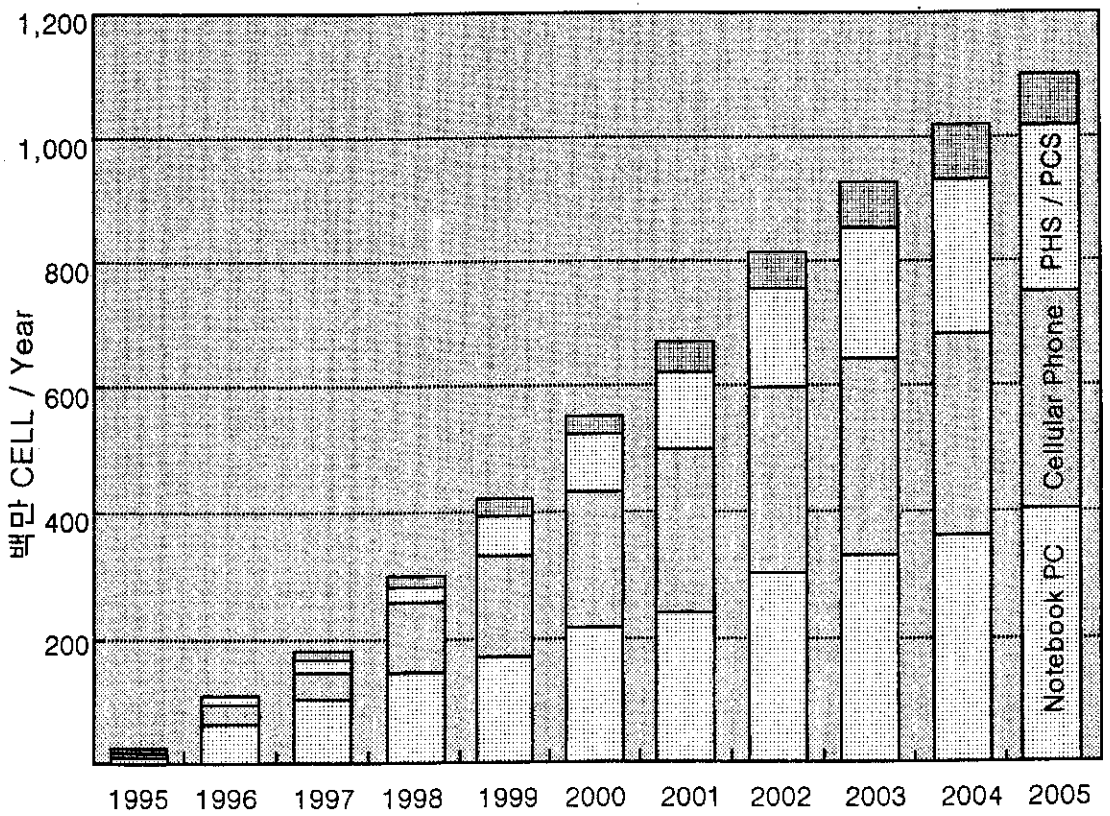
목 차

소형 2차 전지 비교

종류	장점	단점	Application	Market (1997)
Ni-Cd	- 대전류 방전 - 저가 - 장 수명	- 메모리 효과 - 저 에너지 밀도 - Toxic한 Cd 함유	- 전문가용 Power tool - Toy	- 1900억엔 (38%) 14억 cell - 정체, 고유 시장 확보
Ni-MH	- 중 전류 방전 - 고 에너지 밀도 - 환경 친화 - 대형화 유리	- 저 전압 (1.2V) - Heavy - 중 저가 - 약 메모리 효과	- 저가 3C - 무전기 - 비전문가용 Power tool - HEV, EV	- 1100억엔 (22%) 6억 cell - 금액 정체, 수량 증가 - 전동 공구, 대형 전지 시장 진출
Li-ion	- 고 에너지 밀도 - 고 전압 (> 3.6 V) - 경량 - 메모리 효과 없음 - 다양한 전극 재료	- 고 가 - Multiple protection - 대형화 불리	- 3C - 고전압 단cell - (HEV, EV)	- 2000 억엔 (40%) 2억 cell - 금액, 수량 급 성장 - 3C 시장 주도

리튬 이온 2차 전지 수요 예측

Li-ion Battery



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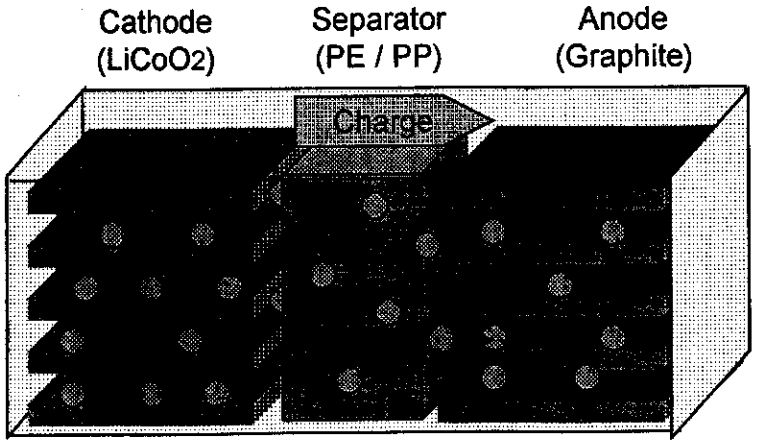
< Charge & Discharge of LIB >

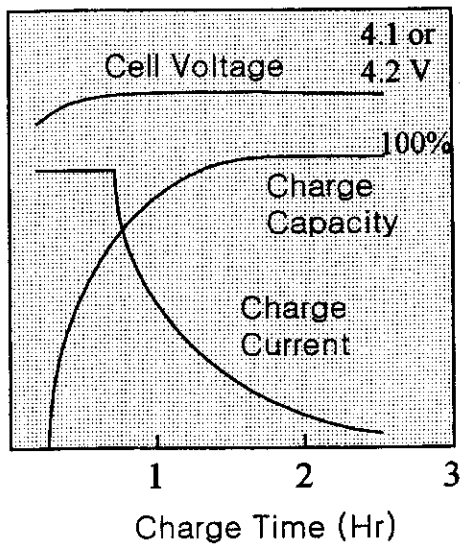


In Non-aqueous Electrolyte ($LiPF_6$)

$$LiCoO_2 + C \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftharpoons}} Li_{1-x}CoO_2 + CLi_x$$

< CC-CV Charge >

- Constant Current / Constant Voltage
- Overcharge vs. Cycle life & Safety



1C (cc-cv) charge / 2.5 hr

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Cylindrical & Prismatic LIB

< ICR18650 >

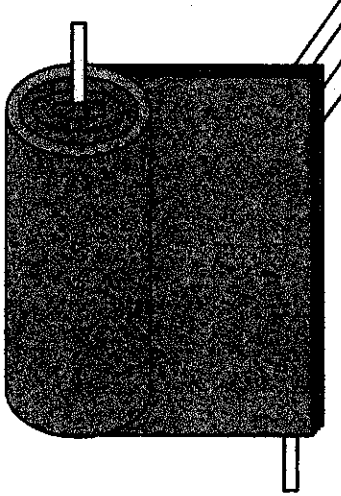
I - Intercalation
C - Co
R - Round
18 - diameter (mm)
650 - height (mm)

Top Cap
-Safety vent
-PTC
-Gasket

Jelly Roll
- Cathode
- Anode
- Separator
- Tab

Electrolyte

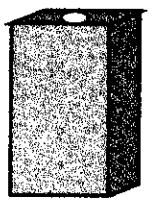
Can



Separator
Anode
Separator
Cathode

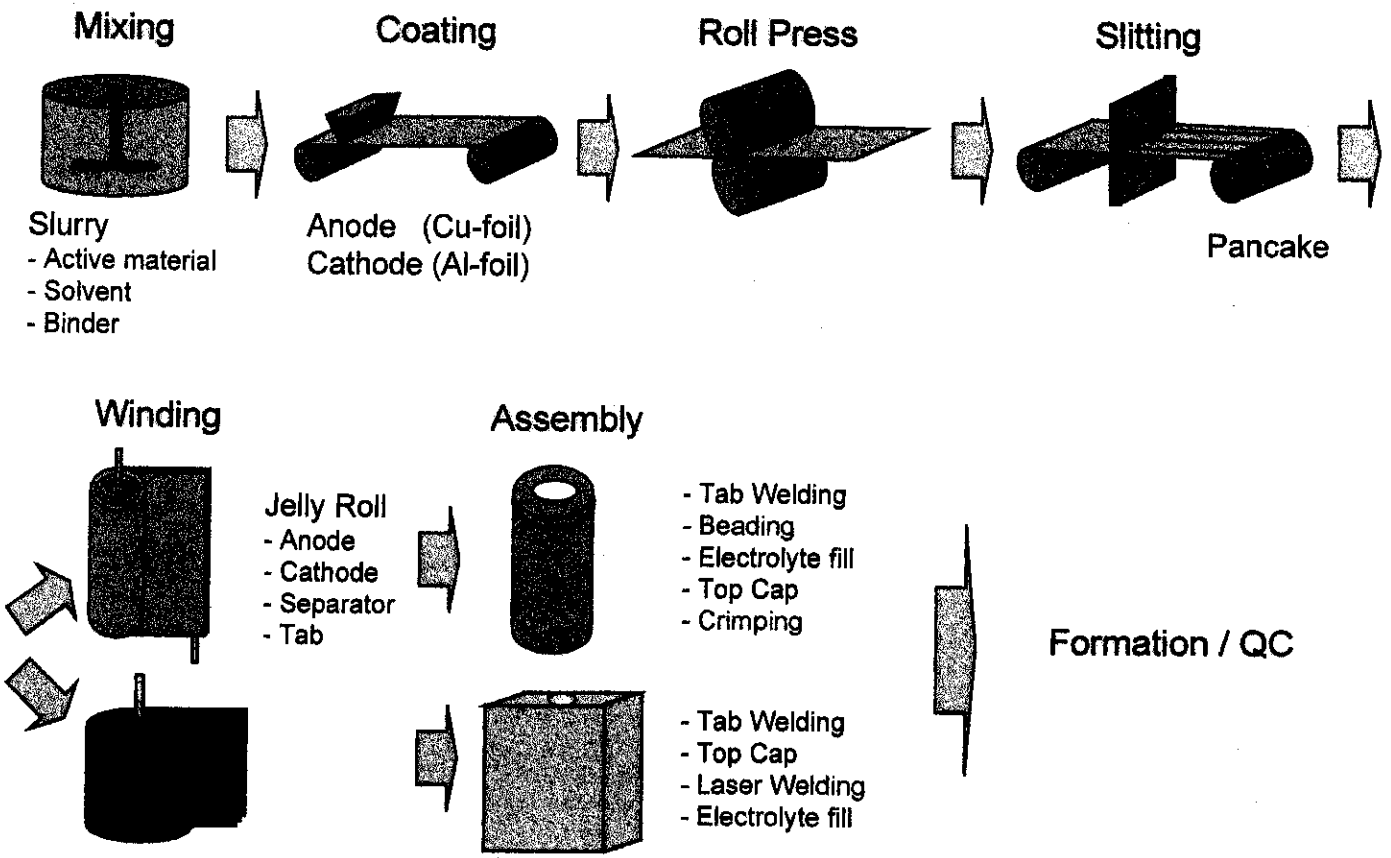
< ICP340848 >

I - Intercalation
C - Co
P - Prismatic
34 - width (mm)
08 - thickness (mm)
48 - height (mm)

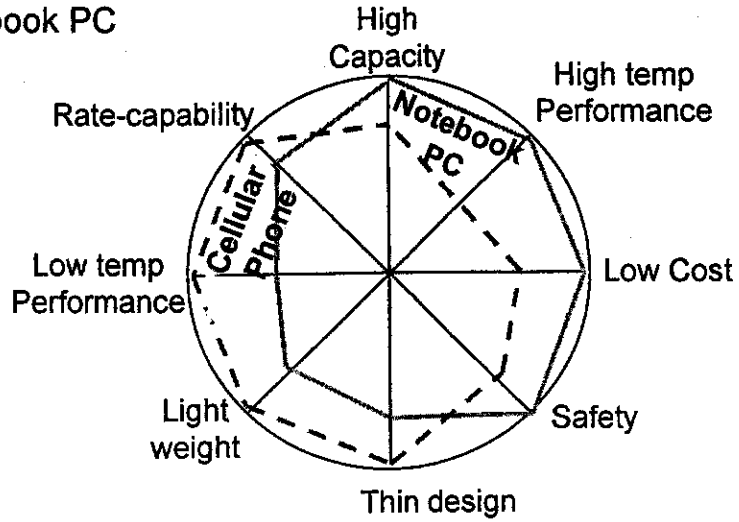


By IEC standard
(International Electrotechnical Commission)

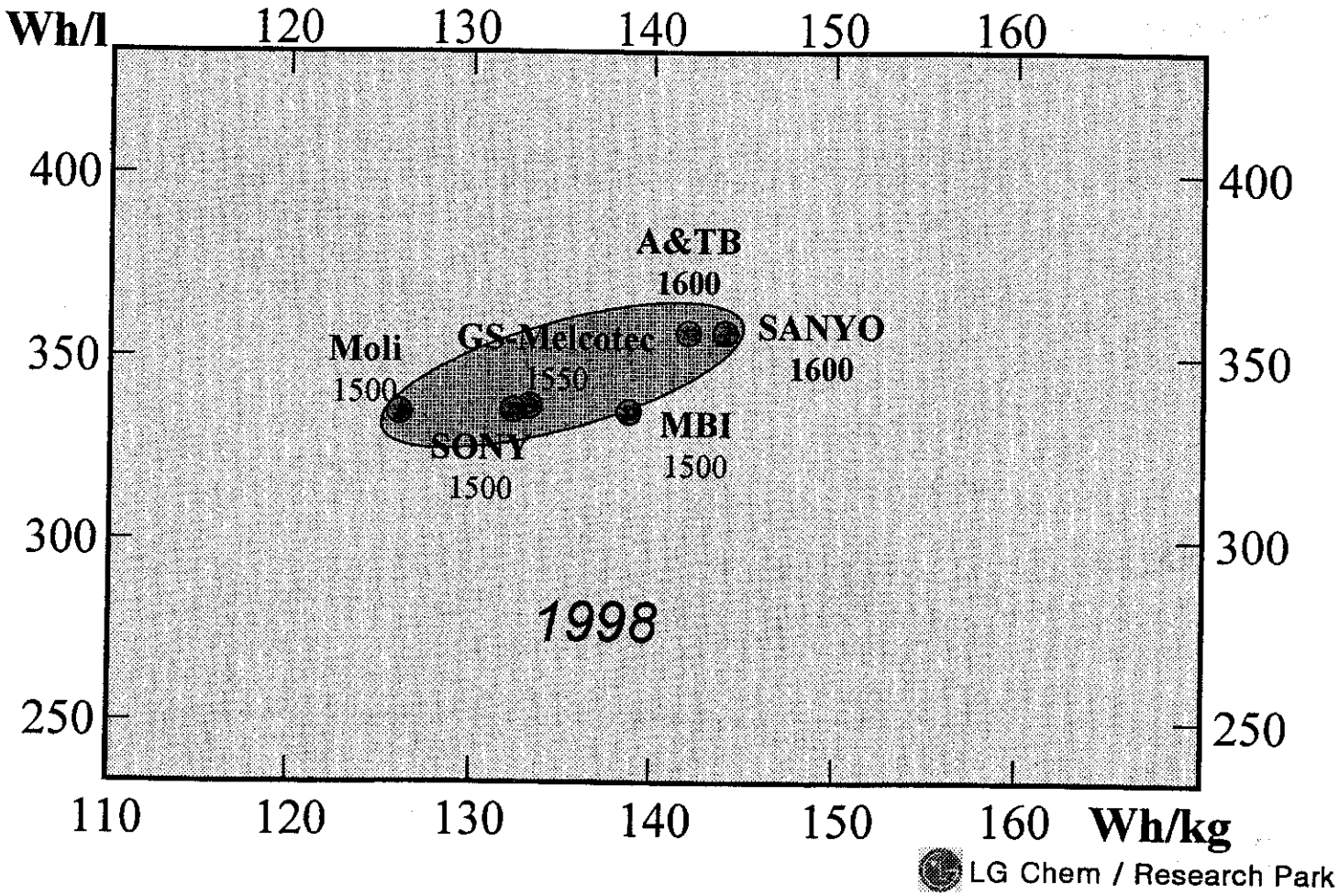
Manufacturing Process of LIB



Mainly Phone & Notebook PC



Batteries for Cellular phone	Batteries for Notebook PC
- Prismatic LIB (8~6~4T) - PLI (free size)	- 18650 LIB - 103450 LIB


Wh/l
120
130
140
150
160
400
350
300
250
A&TB
1600
Moli
1500
GS-Melcotec
1550
SANYO
1600
MBI
1500
SONY
1500
1998
110
120
130
140
150
160
Wh/kg
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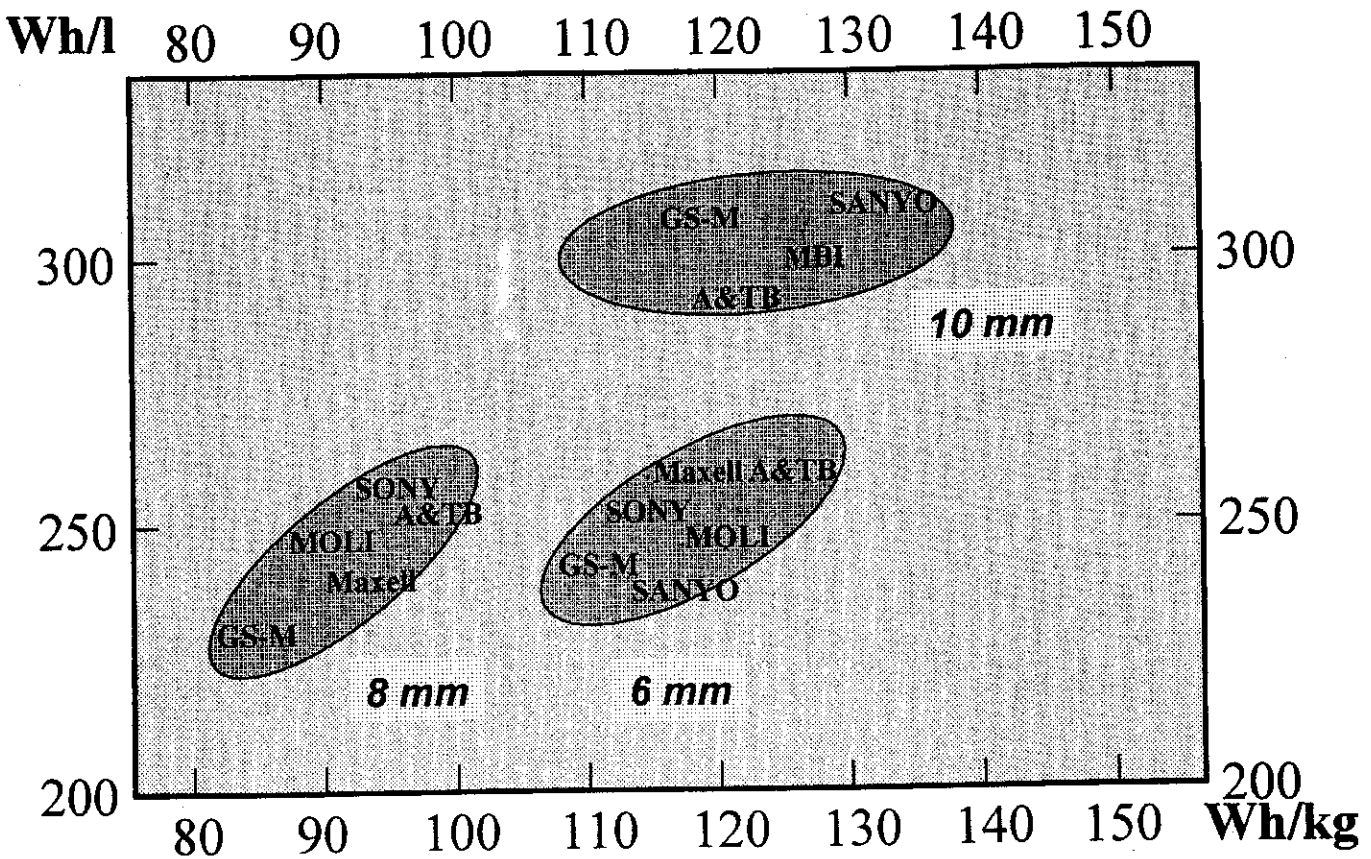

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Taejon, KOREA

- Petrochemicals & Polymers
- Specialty Chemicals
- Biotechnology
- Materials for Information Tech
- Batteries

Since 1979

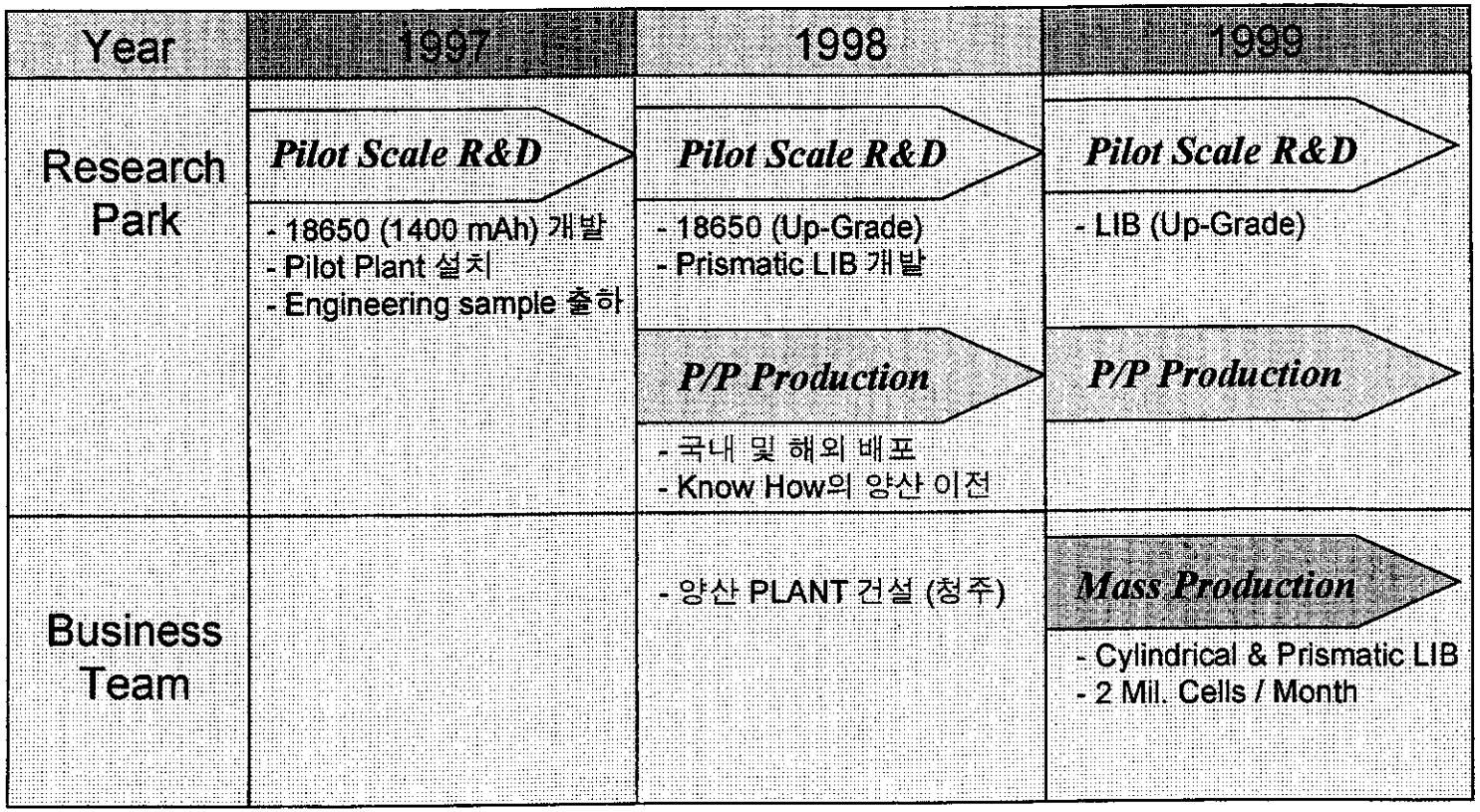
Pollution-free agricultural chemicals

Cephalosporin antibiotics

HCFC resistance resin

Quinolone antibiotics

Li-Ion Batteries



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- ***Performance***

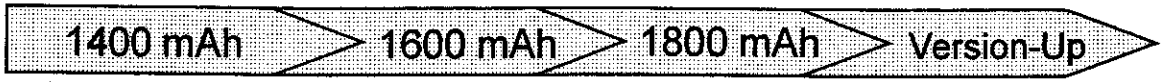
  - *High Energy Density*
  - *Good Rate Capability (2C)*
  - *Good Low Temperature Discharge (-20 °C)*
  - *Good Cycle Life (500 Cycles)*
  - *Light Weight*
  - *No Memory Effect*

- ***Safety***

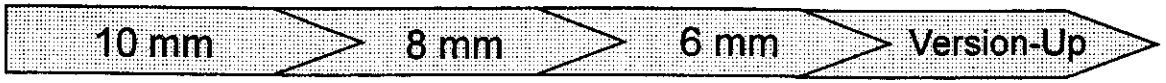
  - *Impact Test*
  - *Crush Test*
  - *Nail Penetration*
  - *Drop Test*
  - *Short Circuit*
  - *Overcharge*
  - *Over discharge*
  - *Hot Box*

(Test Scheme from UL1642 & JSBA)

- Cylindrical Cells (18650)

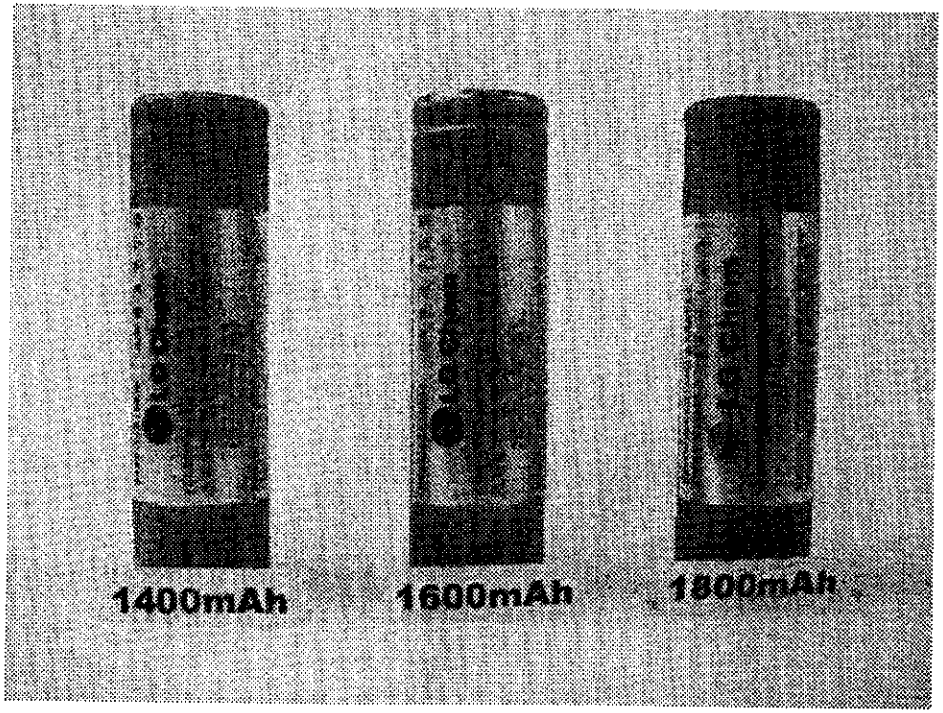


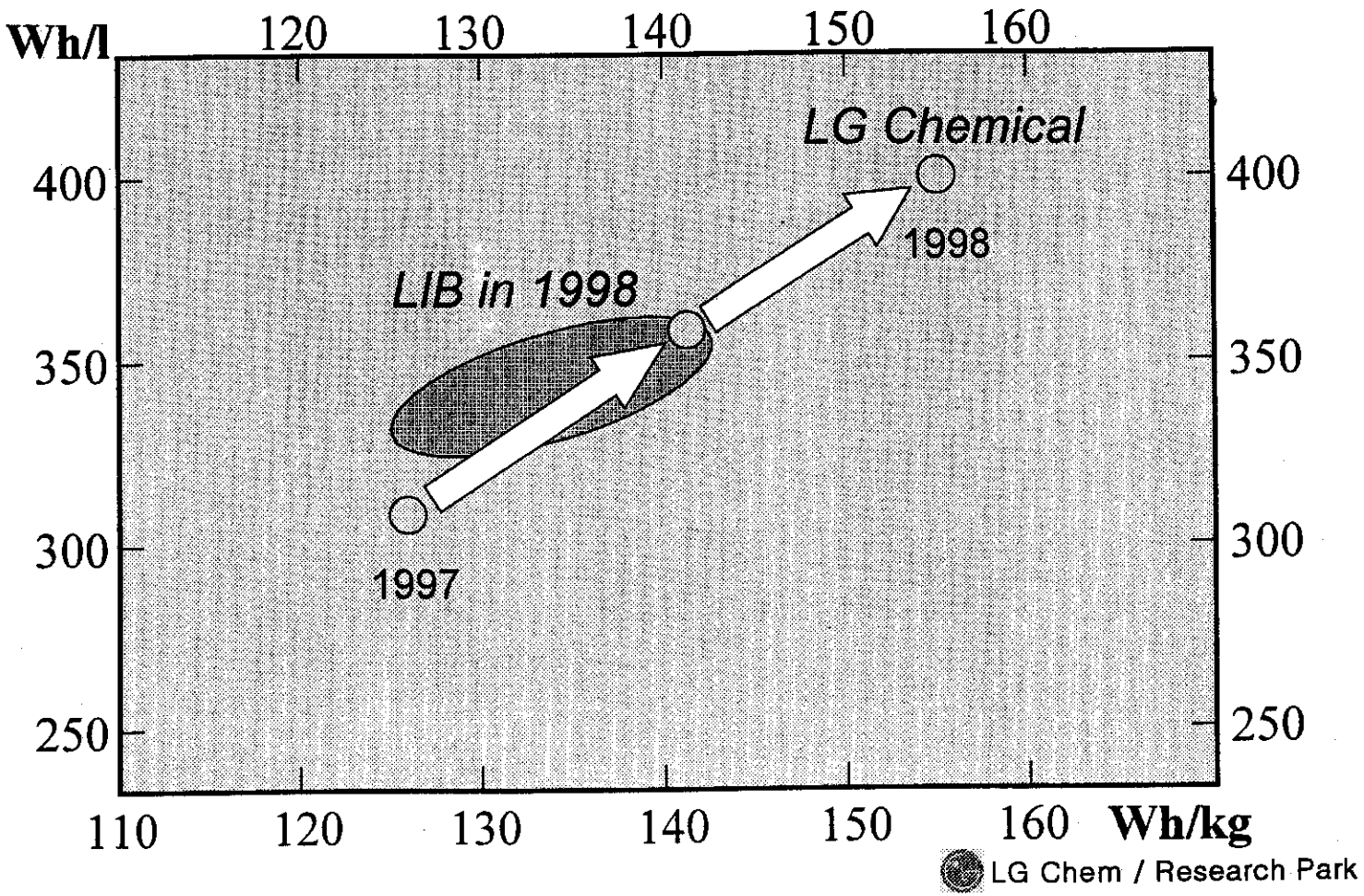
- Prismatic Cells



- Nominal Voltage	*3.7 V*
- Rapid Charging	*1C CC/CV 2.5 hrs*
- Discharge $V_{cut\text{-}off}$	*2.75 Volt*
- Rate Capability	*2C Rate*
- Low Temp Discharge	*-20 °C*
- Cycle Life	*500 cycle*

< 18650 Cylindrical Cells >




Wh/l
120
130
140
150
160
400
350
300
250
LG Chemical
1998
LIB in 1998
1997
110
120
130
140
150
160
Wh/kg
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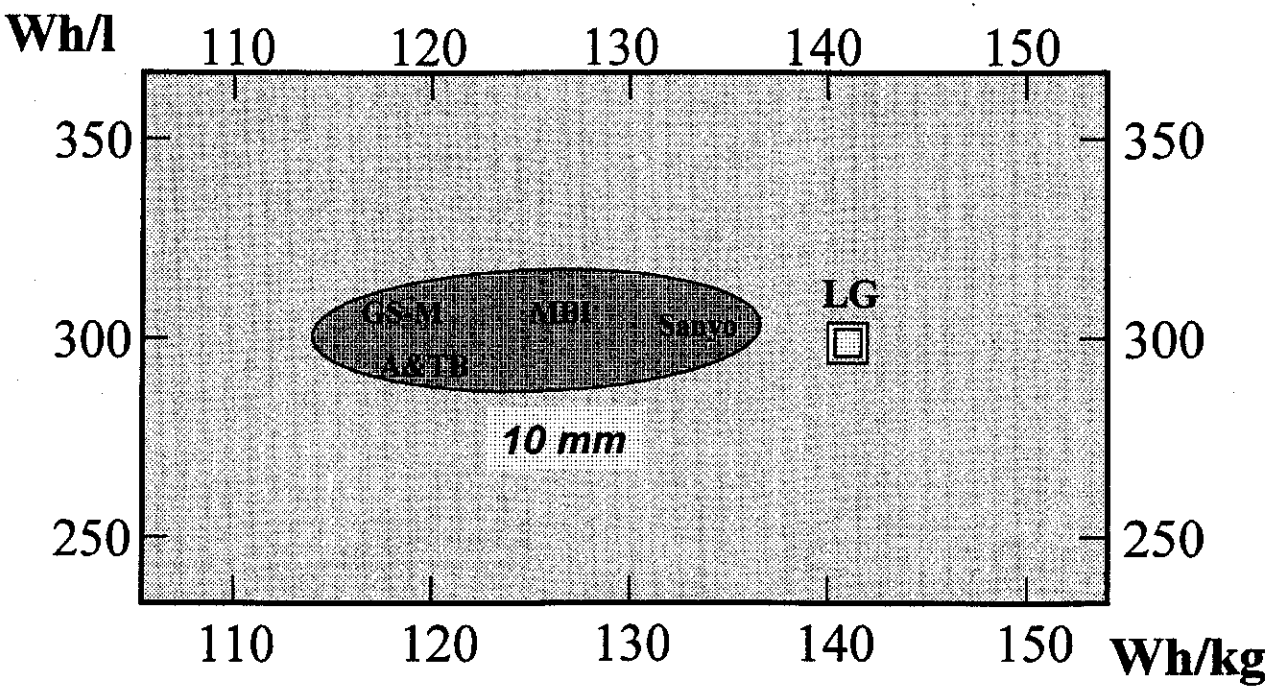
Wh/l
110
120
130
140
150
350
300
250
GS&M
A&TB
ABL
Sanyo
LG
10 mm
Wh/kg

Safety Test / UL 1642 & JSBA

Li-ion Battery

- UL / Underwriter Laboratories Inc. (founded in 1894, not-for-profit Organization)
- JSBA / Japanese Storage Battery Association (日本 蓄電池 工業 協會)

SAFETY TEST SCHEME	Test	REQUIREMENTS	RESULT
<Electrical Abuse Test>			
– External Short Circuit (60°C)	UL	No Explosion, No fire	PASS
– Forced Discharge (2.5C/I_d hr, at I_d)	UL	No Explosion, No Fire	PASS
– Abnormal Charge (2.5C/3I_c hr, at I_c)	UL	No Explosion, No Fire	PASS
– High Current Charge (3I_c,100%charge)	JSBA	No Explosion, No Fire	PASS
<Mechanical Abuse Test>			
– Impact Test (8mm bar, 9kg, 60 cm)	UL	No Explosion, No fire,	PASS
– Crush Test (17.2 Mpa/P, 3000 pound/F)	UL	No Explosion, No Fire	PASS
– Drop Test (1.9 m)	UL	No Explosion, No Fire	PASS
– Drop Test (10 m)	JSBA	No Explosion, No Fire	PASS
– Nail Penetration Test (d=2.5 mm)	JSBA	No Explosion, No fire	PASS
<Environmental Abuse Test>			
– High Temp. Storage (100°C, 5hr)	JSBA	No Explosion, No Fire	PASS
– Heating Test (Hot Box 150°C, 10 min)	UL	No Explosion, No fire	PASS
– Heating Test (Hot Plate 130°C)	JSBA	No Explosion, No Fire	PASS
– Water Immersion (24 Hr)	JSBA	No Explosion, No Fire	PASS
– Vacuum Test (11.6kp, 6Hr)	JSBA	No Explosion, No Fire	PASS