

**The World's Best Material Partner**

**Daejoo Electronic Materials**



## **Disclaimer**

**We notice that the contents of this material can be modified depending on future economic situations or industry changes, and this material is only for introduction to the company and cannot be used for other purposes.**

**Aug. 2024**

**President & CEO IL-JI LIM**

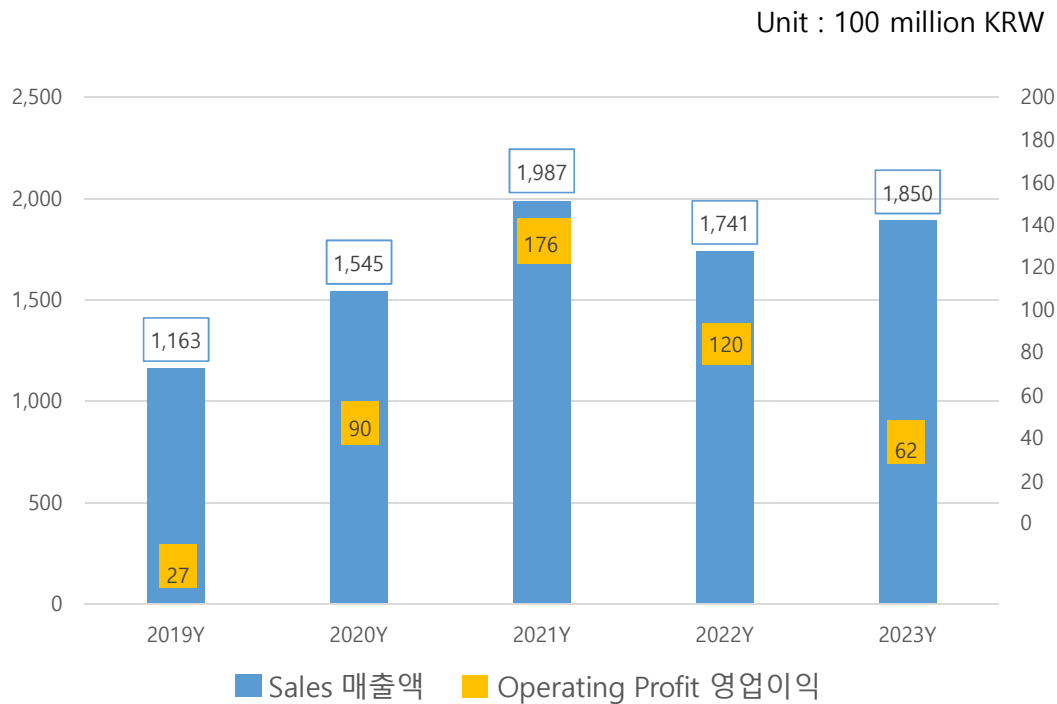
# Contents

- **Company introduction**
- Silicon Anode Technology of Li ion battery
- Silicon anode market and Daejoo


# Overview

Our mission is to be a global top maker in the field of silicon anode material in LIB and the field of electronic material industry.

## DAEJOO 5 years Financial Statements



## 2023Y DAEJOO Overview

Establishment <b>Jul. 1981</b> (43 <sup>rd</sup> year)	Registered (KOSDAQ) Dec. 2004	CEO <b>IL-JI LIM,</b> <b>JOONGKYU LIM</b>
Sales ('23) <b>185 Billion won</b>	 <b>DAEJOO</b>	Operating Profit <b>62 Billion won</b>
Capital <b>7.7 billion</b>	Employee <b>380</b>	Growth centered on silicon anode material

# History



# SITES

Shanghai (1996. 3~)

- Conductive pastes
- Epoxy coating



Qingdao (2003. 1 ~)

- Epoxy coating



HQ (1981. 7~)

- Conductive pastes
- Silicon Anode
- Phosphors



USA (2014. 10~)

- Conductive pastes
- Silicon Anode

Vietnam (2022. 6~)

- PIG Phosphors



Dongguan (2004. 10~)

- Conductive pastes
- Epoxy coating
- Silicon Anode



Taiwan (2002. 2 ~)

- Conductive pastes






# Siheung Battery Campus(2<sup>nd</sup> Factory) for Silicon Anode Materials

**Expanding** capacity to meet dramatically increasing global demands

## Land

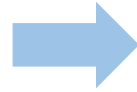
	Area	
Headquarter	10,925.1m <sup>2</sup>	 HQ
<b>MTV</b>	<b>46,897.4m<sup>2</sup></b>	
<b>New Factory</b>		



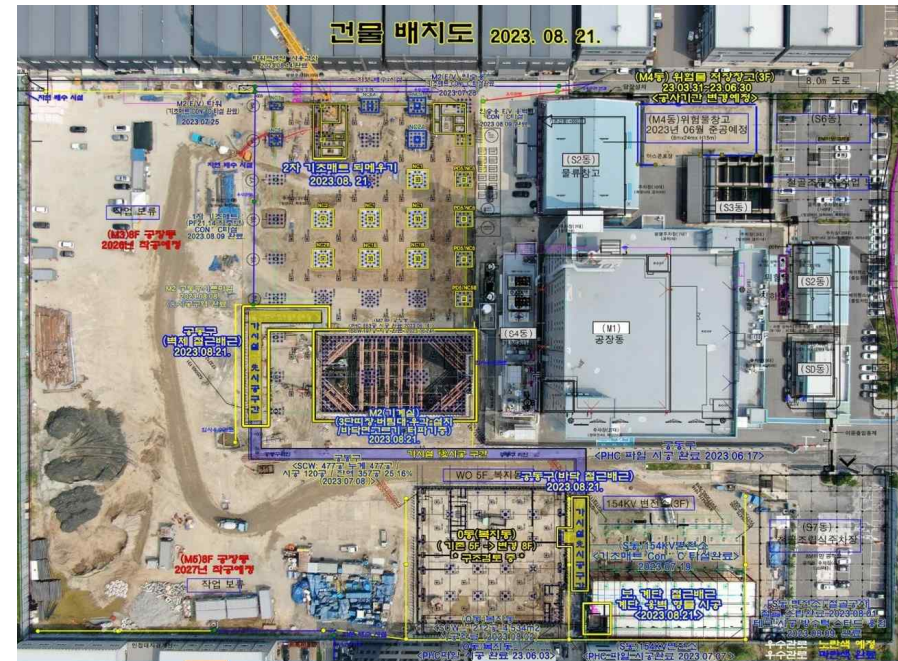
2nd factory area which is **4 times** wider than HQ

# Production Capacity Road Map (Siheung Battery Campus)

HQ (10,925.1 m<sup>2</sup>) DMSO : 300 ton/Y



Siheung Battery Campus (2020~/ 46,897.4 m<sup>2</sup>)





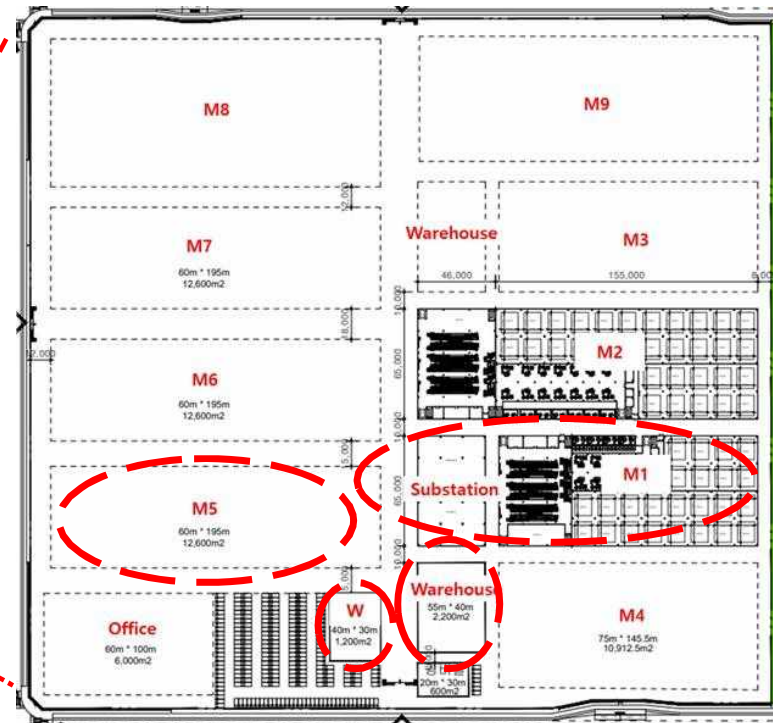
# Saemangeum Battery Campus(3<sup>rd</sup> Factory) for Silicon Anode Materials



Headquarters ↔ Saemangeum battery campus  
(200km)



3<sup>rd</sup> Anode material Plant (2026~ / 188,100m<sup>2</sup>)



# 사업 분야



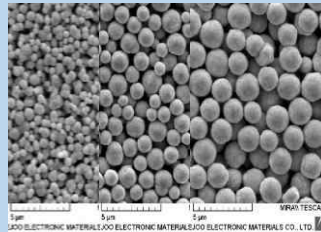
## Conductive paste

Internal/external electrode pastes for components ( MLCC, Chip inductor, Variator etc.)



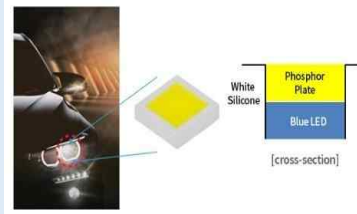
## Conductive powder

Conductive powder, Solar cell, metal filler of Ag paste for internal / external electrode of chip component



## Phosphors

Phosphor powders with excellent light conversion eff. & reliability  
Fluorescence conversion plates with excellent high temp. & high reliability



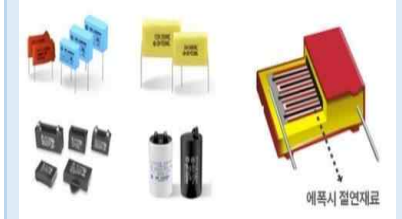
## Silicon Anode materials

Si-based anode materials with higher capacity (1300~1700 mAh/g), used in Lithium Ion Battery



## Polymer

Compound using epoxy resin for electrical & electronic paints with excellent reliability (mechanical strength, moisture resistance, heat resistance, electrical properties)



# Conductive Paste

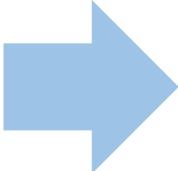
Internal/external electrode pastes are applicable to components such as MLCC, Chip Inductor/Varistor etc., in the field of IT, automobiles, industrial electric devices.

**Product** Electrode pastes

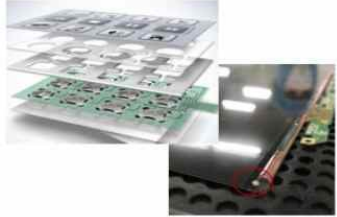


**Main customer**  
: Samsung electro-mechanics, Hanwha Solutions, Partron, Amotech, Walsin etc

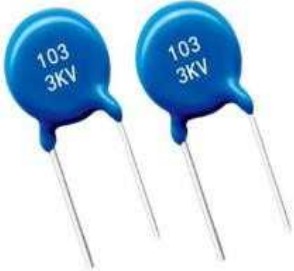
**Application**



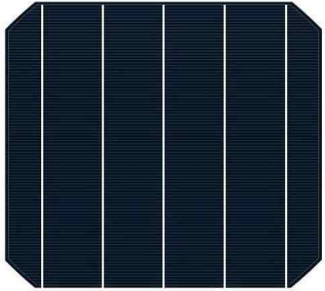
**Chip component (MLCC)**



**Electronic component (Membrane switch, Anti-static)**



**Electronic component (Ceramic capacitor, Varistor)**



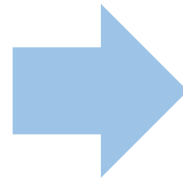
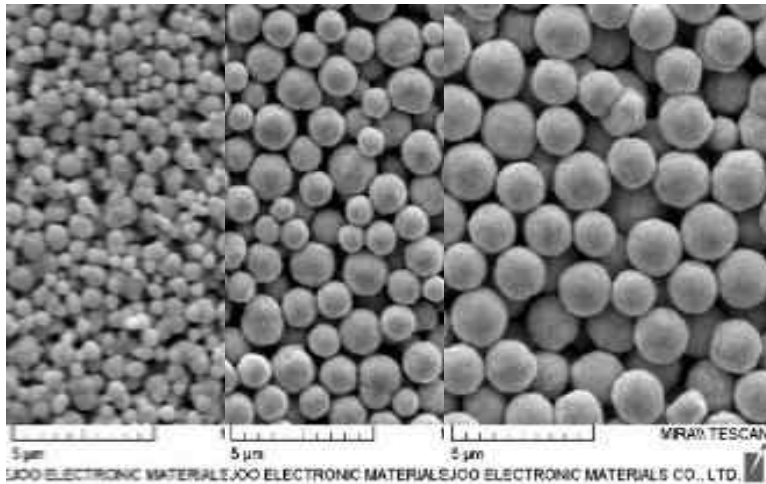
**Solar cell**

## Conductive Powder

Conductive powders are applicable to Solar cell, PDP Ag electrode, metal filler of Ag paste for internal and external electrode of chip component

### Product

Powder for electrode powder



### Application

Internal / external electrode, low temperature curing type paste



Major customer:

Used as a material for our products. Only in the world to internalize conductive powder



# Polymer

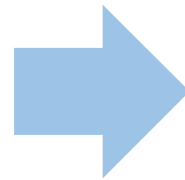
Our polymer models are used for electrical insulation in electronic devices or components, They have excellent mechanical strength, moisture resistance, heat resistance, and electrical properties

## Product

Solid epoxy



Liquid epoxy



## Application



Passive component  
(L·R·C, Varistor etc.)



Field coil f  
or automobile  
(Before use)



Field coil f  
or automobile  
(After use)

## Main customer

: Abco electronics, WOORY industrial, Pilkor, Electronics, AUK etc.

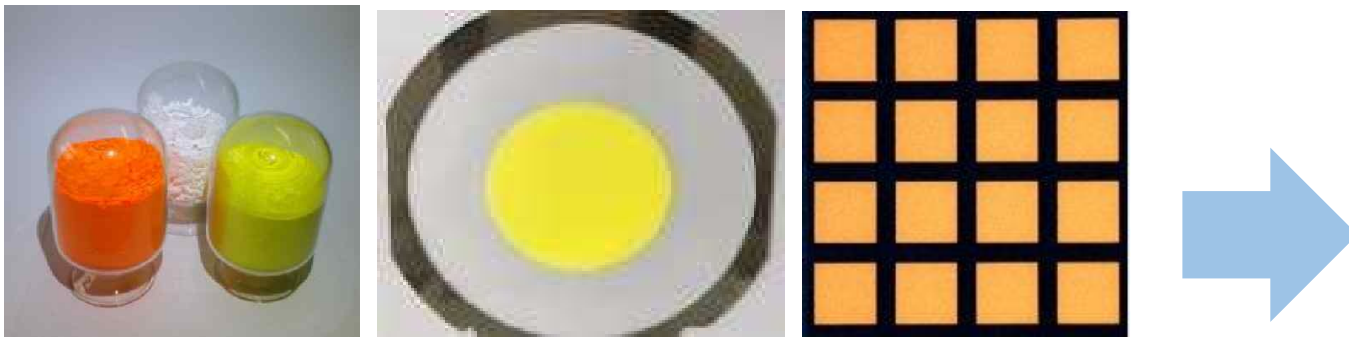


# Phosphor

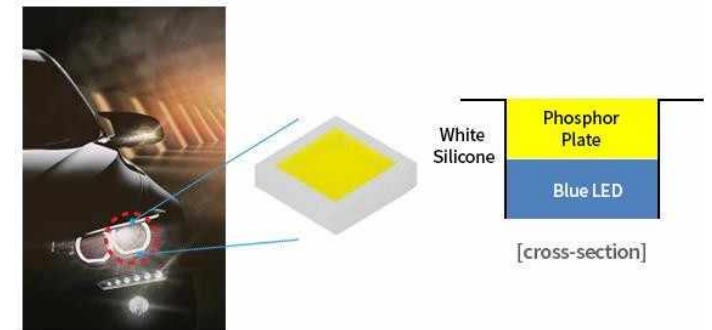
Phosphor powders are showing excellent light conversion efficiency.

Fluorescence conversion plates are having excellent reliability against high temperature and high humidity

## Phosphor & fluorescence conversion plate



## LED light, LED for automobile



**Main customers**  
: Seoul semiconductor, Samsung electronics, Everlight, etc

# Silicon Anode Materials

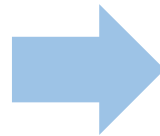
For an anode material for a lithium secondary battery, It is a silicon compound with a capacity (1,400 mAh/g) that is four times higher than that of the existing graphite anode active material (350 mAh/g).

Key Materials for Improving driving range and fast charging of Electric Vehicles

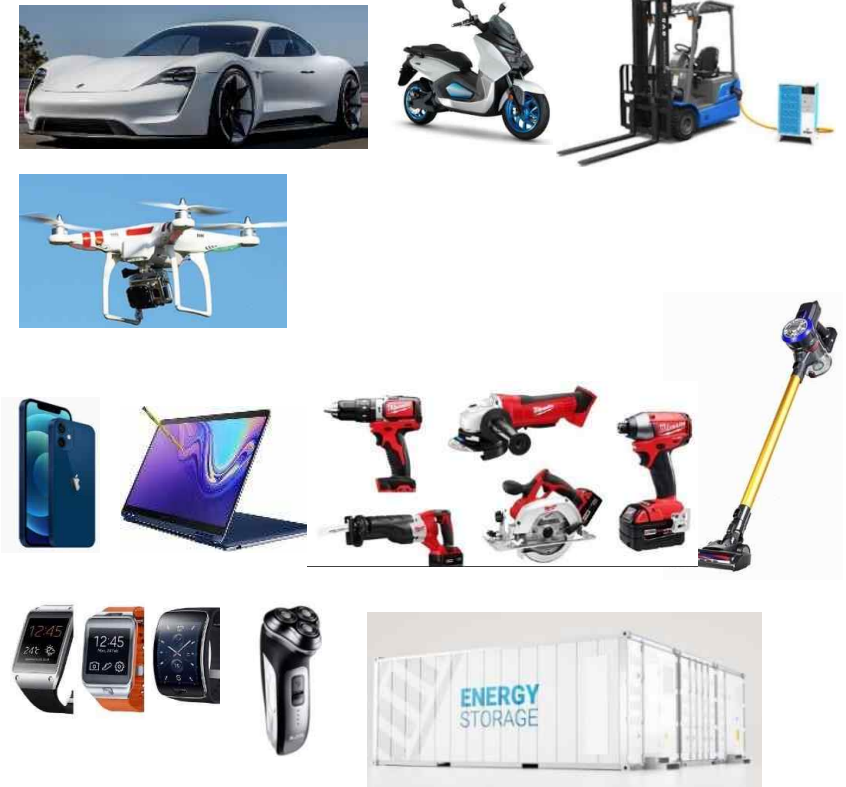
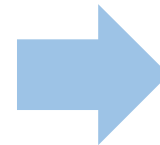
Application fields: Lithium secondary batteries such as EV, drones, IT/Mobile, Power Tools, ESS, etc



**Silicon Anode**  
(Product : DMSO)



**Battery**  
(Pouch, cylinder, square)



-World's First Application to Pouch Cells for Electric Vehicles

- 2019 Porsche Pure Electric Sports Car "Roaded on the Taycan"

-Expanding EV models applied through battery companies

## Major customers



## Sales by product

Unit : 100million KRW

Articles		2018	2019	2020	2021	2022	2023
Conductive	Chip	320	426	400	580	526	447
	Solar cells	50	101	134	160	176	190
	MLCC	300	298	430	580	311	379
	Sub total	670	825	964	1,320	1,013	1,016
Polymer		160	122	194	269	263	208
Phosphors	General	57	25	17	10	6	6
	For vehicles	110	121	140	145	173	247
	Sub total	157	146	157	155	179	253
Anode material for LIB			37	130	210	266	235
ETC		43	34	100	33	20	138
Grand total		1,030	1,164	1,545	1,987	1,741	1,850

## Sales by product in 2Q 2024

Unit : 100million KRW

Articles		'24. 2Q	'24.1Q	'23. 1Q	'23. 2Q	'23. 3Q	'23. 4Q	2023
Conductive	Chip	140	104	104	112	100	131	447
	Solar cells	7	12	41	45	58	46	190
	MLCC	114	99	68	93	111	107	379
	Sub total	<b>261</b>	<b>215</b>	213	250	269	284	1,016
Polymer		<b>58</b>	<b>53</b>	49	56	55	48	208
Phosphors		<b>85</b>	<b>95</b>	46	56	70	81	253
Anode material for LIB		<b>174</b>	<b>87</b>	55	57	57	66	235
ETC		<b>4</b>	<b>13</b>	11	39	88	0	138
Grand total		<b>582</b>	<b>463</b>	374	458	539	479	1,850



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# Graphite vs Silicon

C

Carb

12.011

14

Si

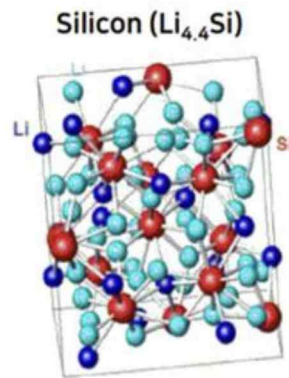
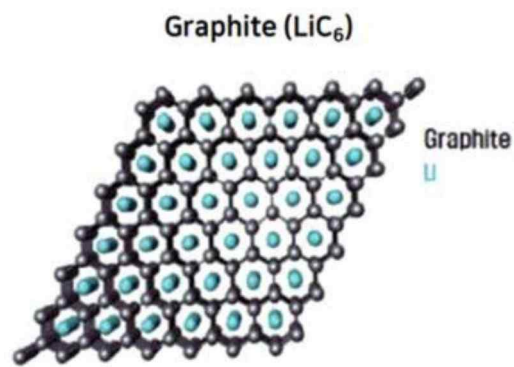
Silicon

28.0855

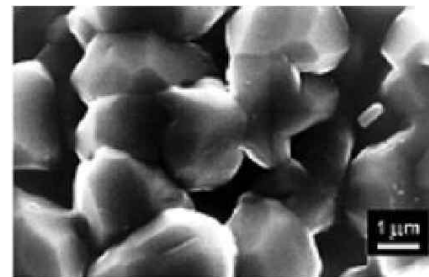
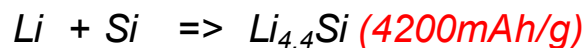
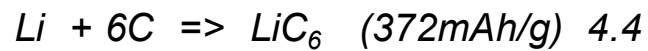
# Merits and demerits of silicon anode materials

## Volume change during charging and discharging

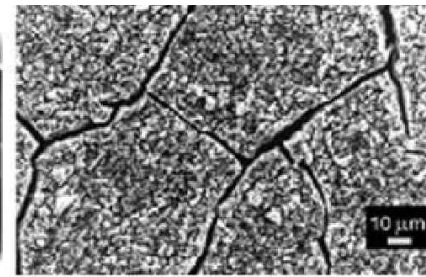
- Fracture and breakage of Si-based anode
- Formation of unstable SEI, degradation of electrode



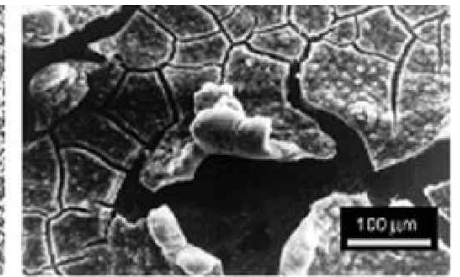
## High charge / discharge capacity



Before cycling



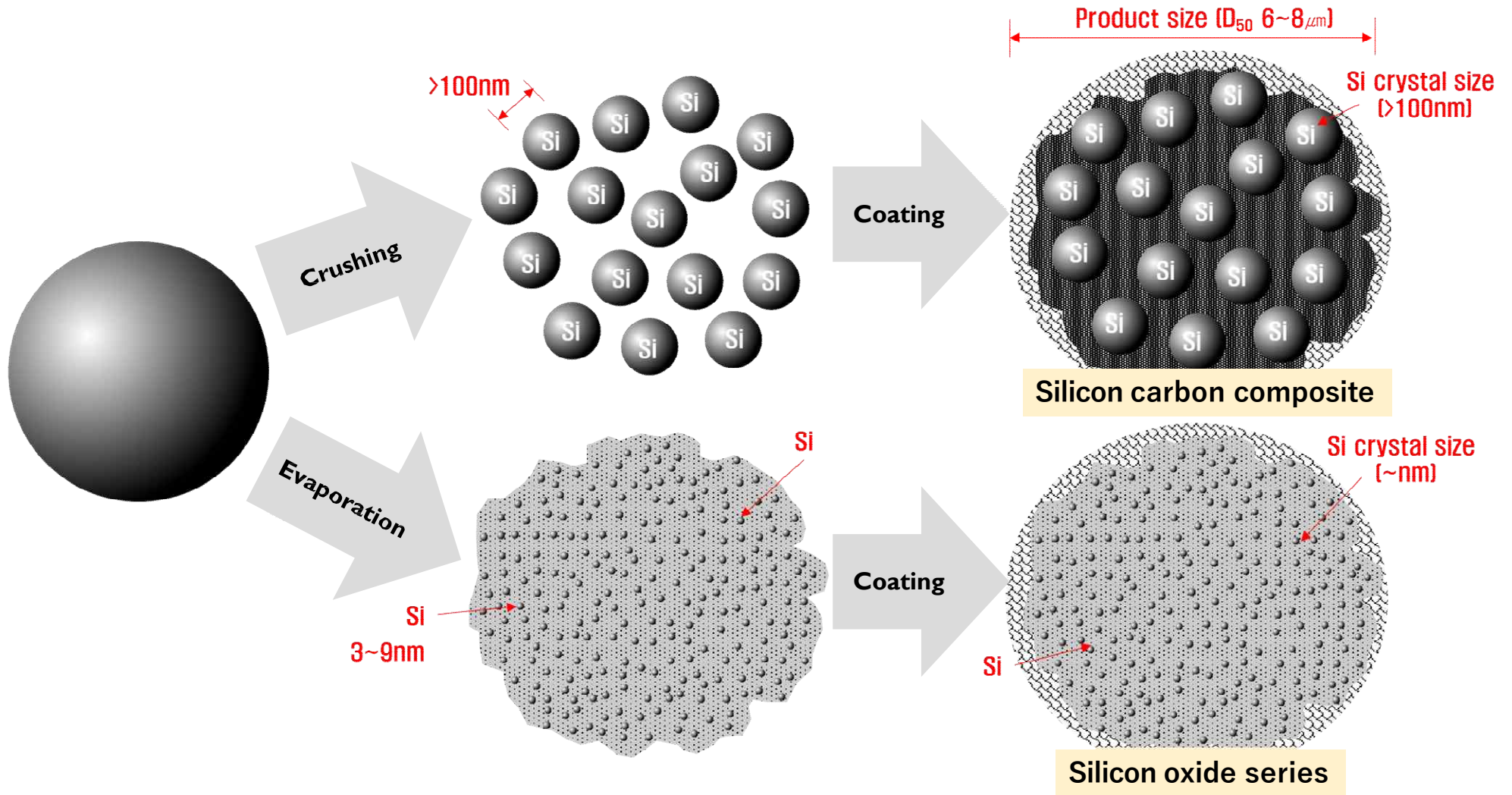
After 2 cycles



After 5 cycles

Ref) Bruno Scrosati and Jurgen Garche, Journal of Power Sources, 195 (2010) 2419.

# Silicon anode materials technology method (SiC vs SiOx)

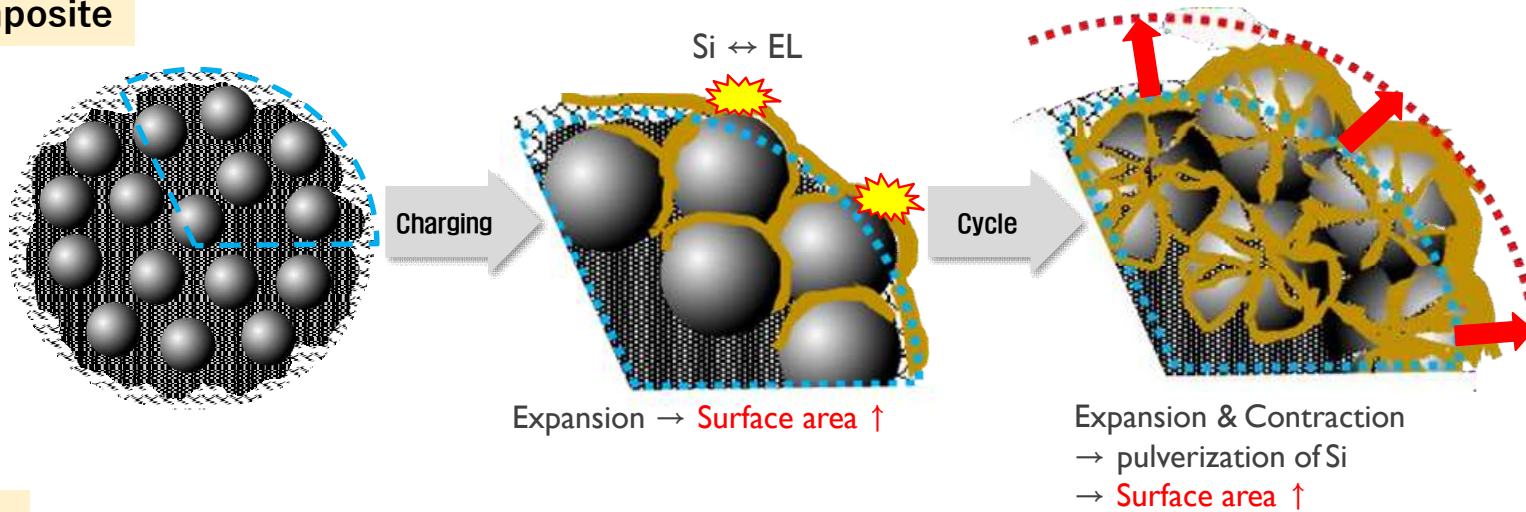




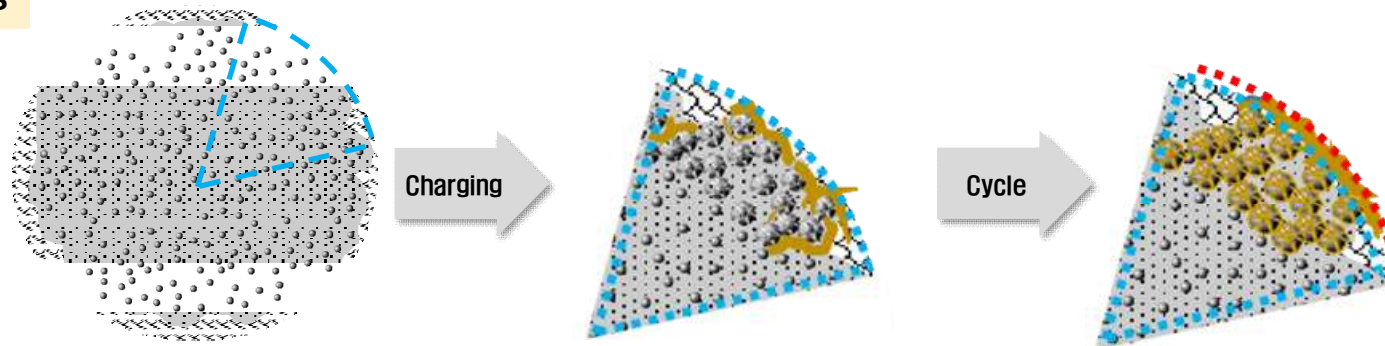
# Comparison of silicon anode materials during charging and discharging

Swelling = expansion of Si + side reaction with EL

## Silicon carbon composite



## Silicon oxide series



The pulverization of Si by expansion and contraction occurs almost inside the matrix.

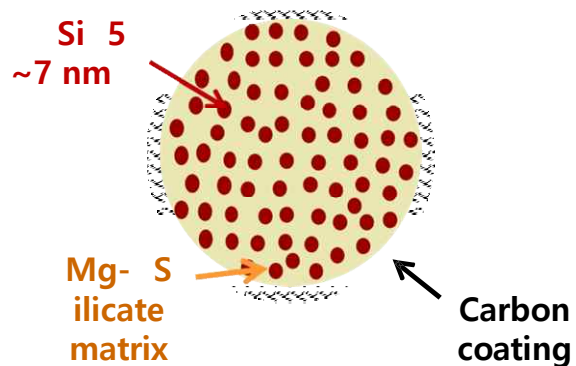


## Next generation products of Daejoo's silicon anode materials

- ❖ Improvement by minimizing silicon crystals (inhibition of expansion/contraction) and minimizing specific surface area (inhibition of side reactions)
- ❖ High capacity and high efficiency are realized simultaneously by controlling irreversible reactions
- ❖ Internalization of core processes (phase synthesis, carbon coating) equipment

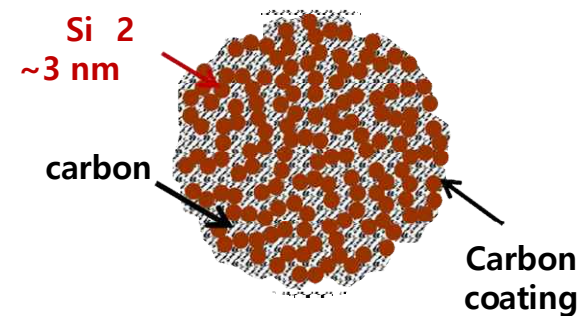
\*Current mass production

High efficiency silicon oxide (DMSO)



\*LAB SCALE performance evaluation

Next-generation silicon anode material



Next-generation silicon anode material,  
High capacity ICE 88%, 1800mAh/g

# Details of next-generation silicon anode in Daejoo

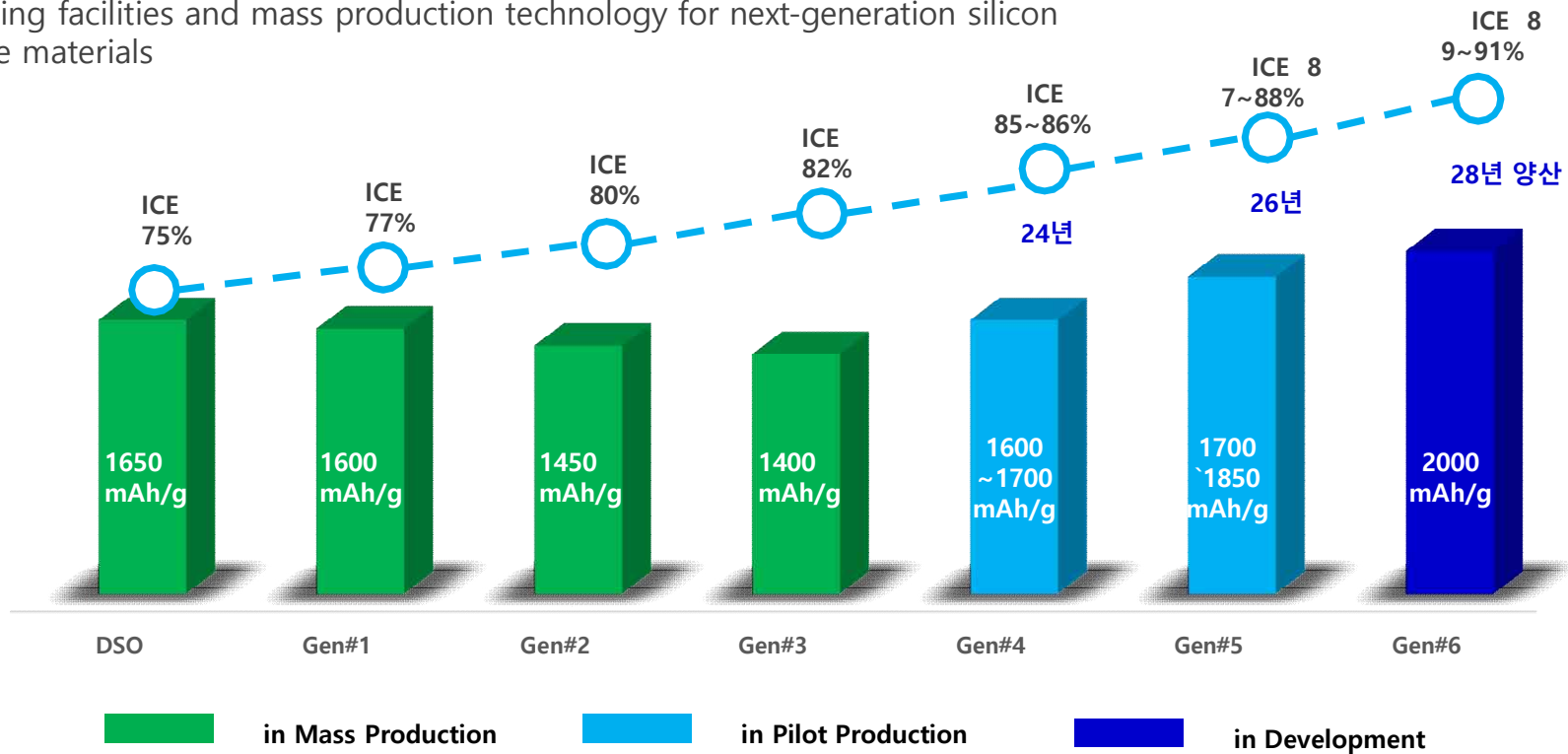
Next-generation silicon anode material, Source patents, competitive initial efficiency/capacity, various product lines, price competitiveness being secured

		<b>Next-generation silicon anode material (Top-down method)</b>
<b>Material</b>		
<b>Main purpose</b>	IT, Powder tool, EV	
<b>Application amount</b>	5 ~ 100% (Anode active material standard)	
<b>Pros and cons</b>	<ul style="list-style-type: none"> <li>• Efficiency (88–92%), Capacity (1900–2500 mAh/g)</li> <li>• Adjustment of Si crystallite size/carbon content allows for a variety of product lines</li> <li>• Securing material patents (top-down method)</li> <li>• High capacity characteristics with high Si content (60-80%) compared to competitive products</li> <li>• Uniform coating on the core and outer edges for storage stability and no gas generation</li> </ul>	
<b>Supplier</b>	<b>Mass production</b>	Preparation for mass production (after 2026)
	<b>Pilot</b>	Establishment of pilot facilities (2024)
	<b>Development</b>	Lab Scale Performance Verification (Customer Evaluation Completed)

# Development of super gap in silicon anode material road map

## ▶ Development of Super Gap Materials

- ❖ Development Efficiency/Capacity Maximization
- ❖ Cost competitiveness to secure waste acid/waste recycling technology for ESG
- ❖ Securing facilities and mass production technology for next-generation silicon anode materials

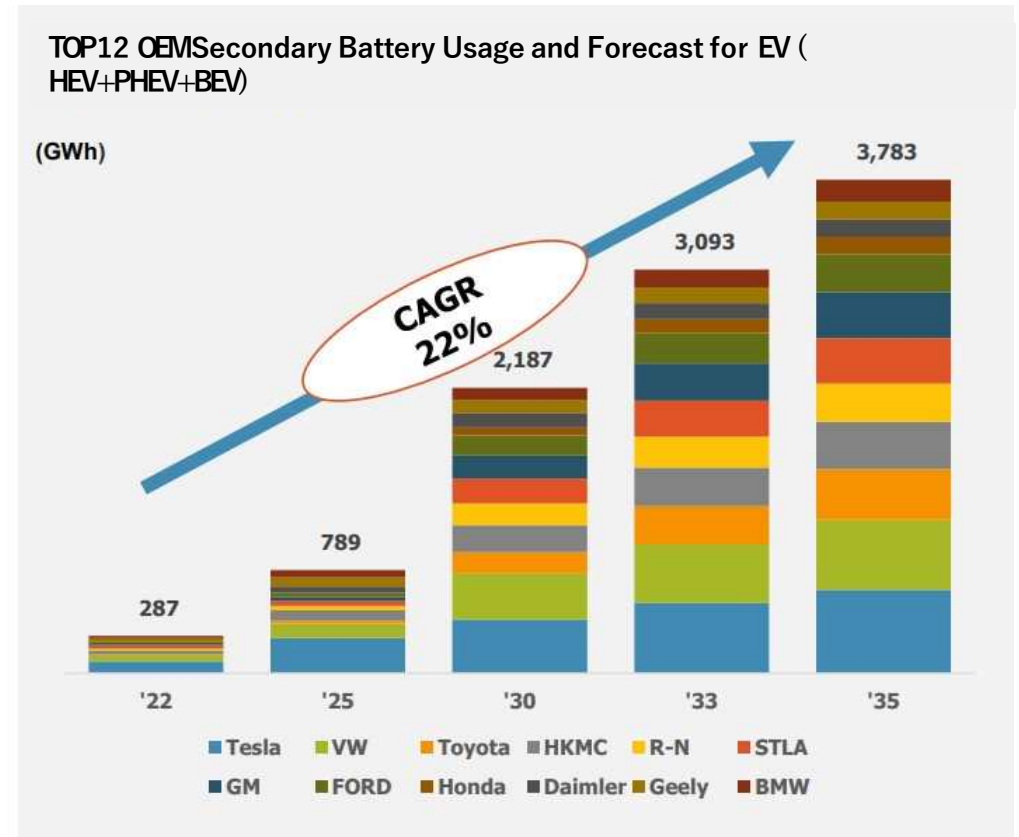
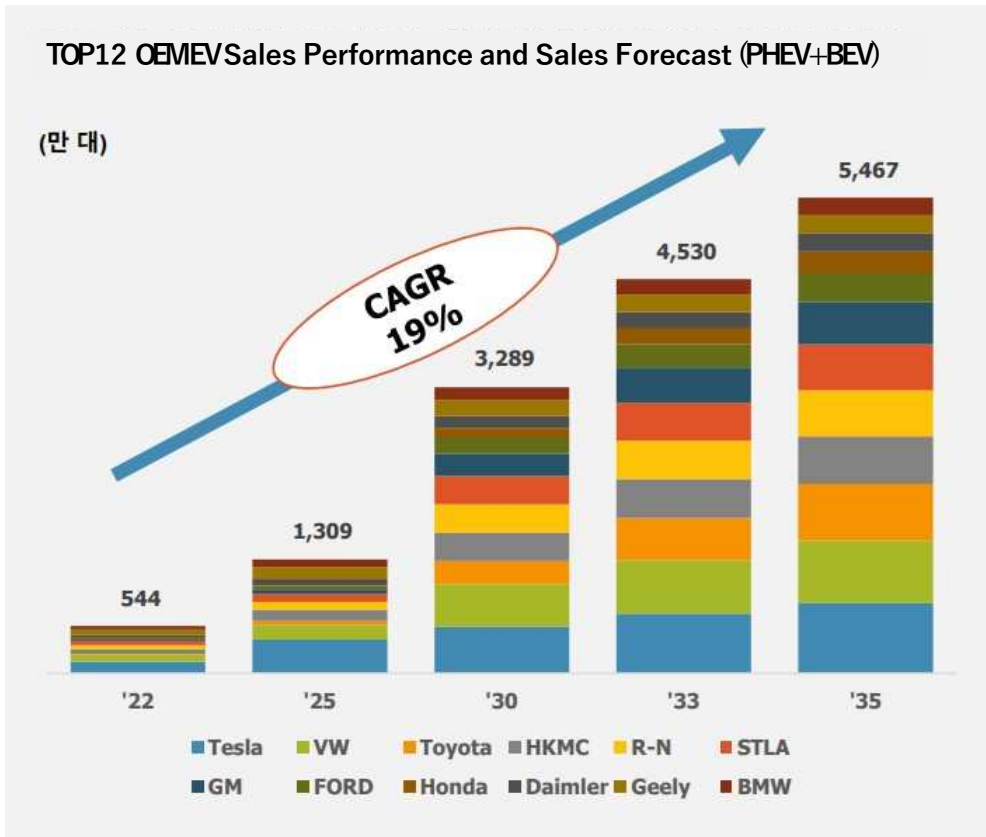


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# EV Market Trend and Outlook

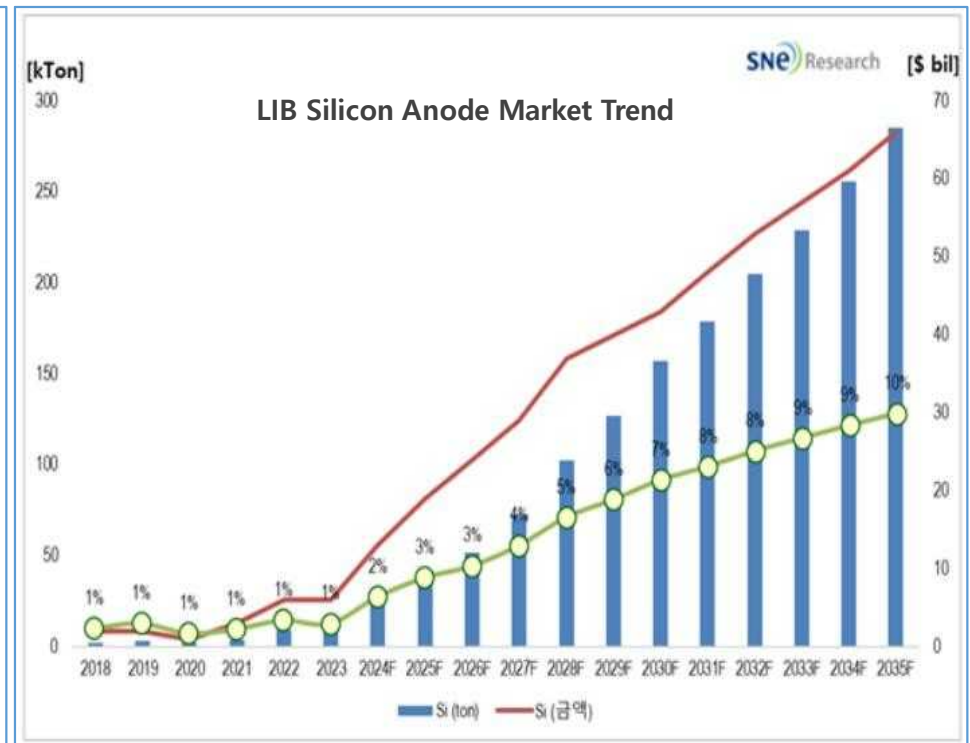
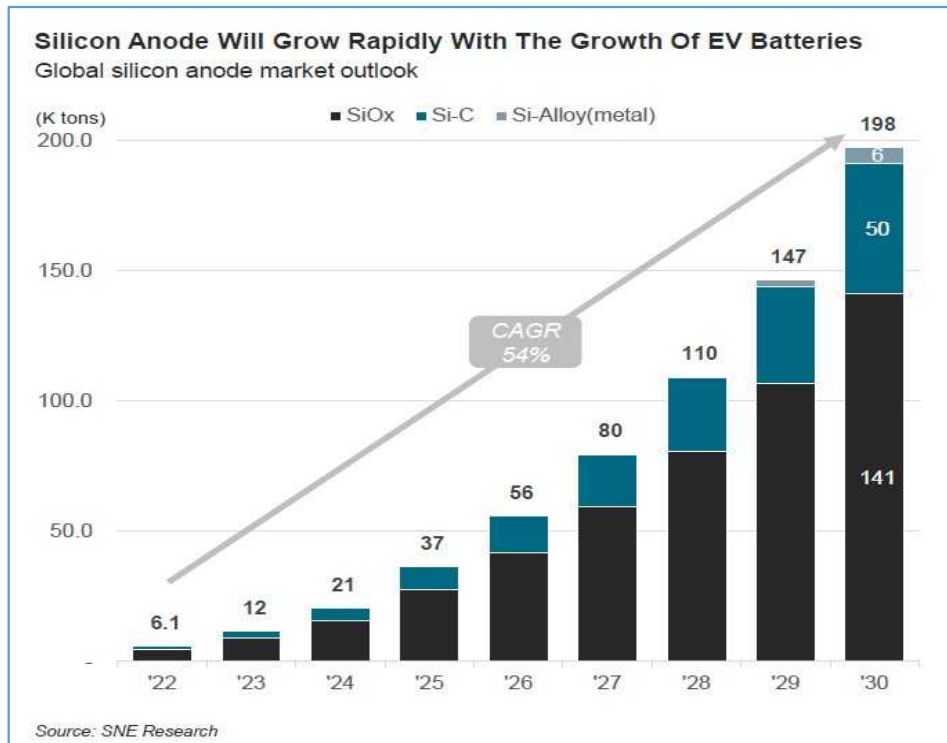
- ❖ Top 12 OEM EV Sales Expected To Reach 32.9 Million Units In 2030
- ❖ Demand for rechargeable batteries will reach approximately 2,190 GWh in 2030, and Tesla will record the most vehicle sales and rechargeable batteries usage by OEM





# Silicon anode market trend and outlook

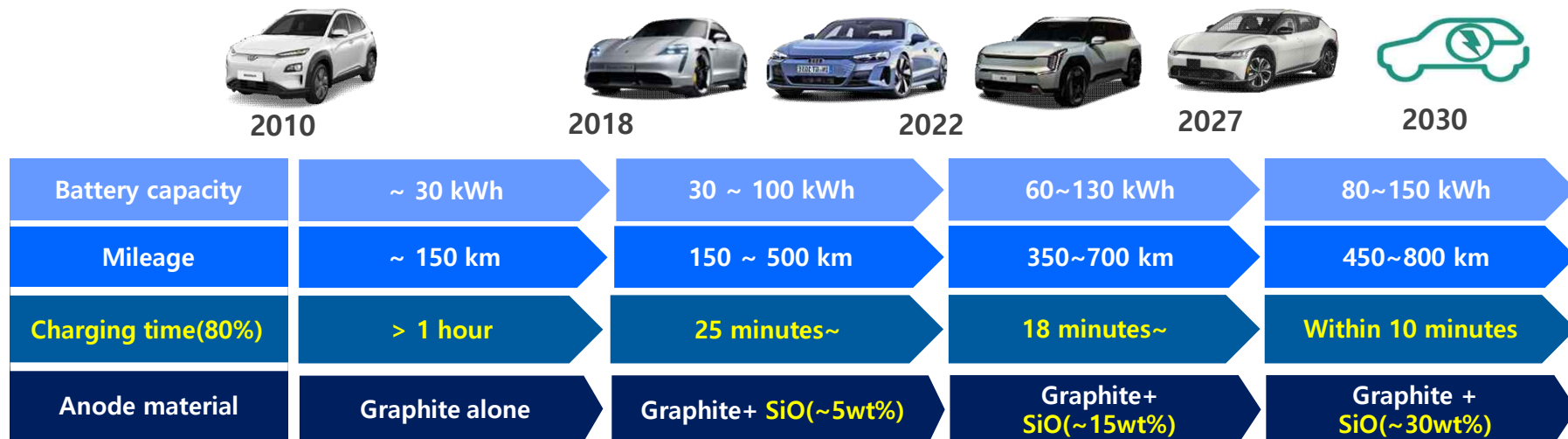
- ◆ Global silicon anode material market **expected to grow at 54% per annum by 2030**
- ◆ Silicon oxide-based anode materials are expected to form the mainstream. Daejoo **hold high-efficiency silicon oxide source patents**
- ◆ High-efficiency and high-capacity silicon materials are continuously required for Si rich design, and our **differentiated technology secures a variety of portfolios**



# The performance roadmap of EV and silicon anode materials

Improvements in mileage and fast charging are needed to expand the electric vehicle market

- It is essential to apply a silicon anode material to the anode active material
- Over the past decade, the EV market has developed technologies focused on increasing energy density.
- The driving force of the EV market is expected to be securing fast charging performance rather than energy density.
- In order to maximize fast charging performance, materials with high efficiency and capacity of silicon materials are essential



# Thank you

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