The World's Best Material Partner

Daejoo Electronic Materials

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Feb. 2024

President & CEO IL-JI LIM

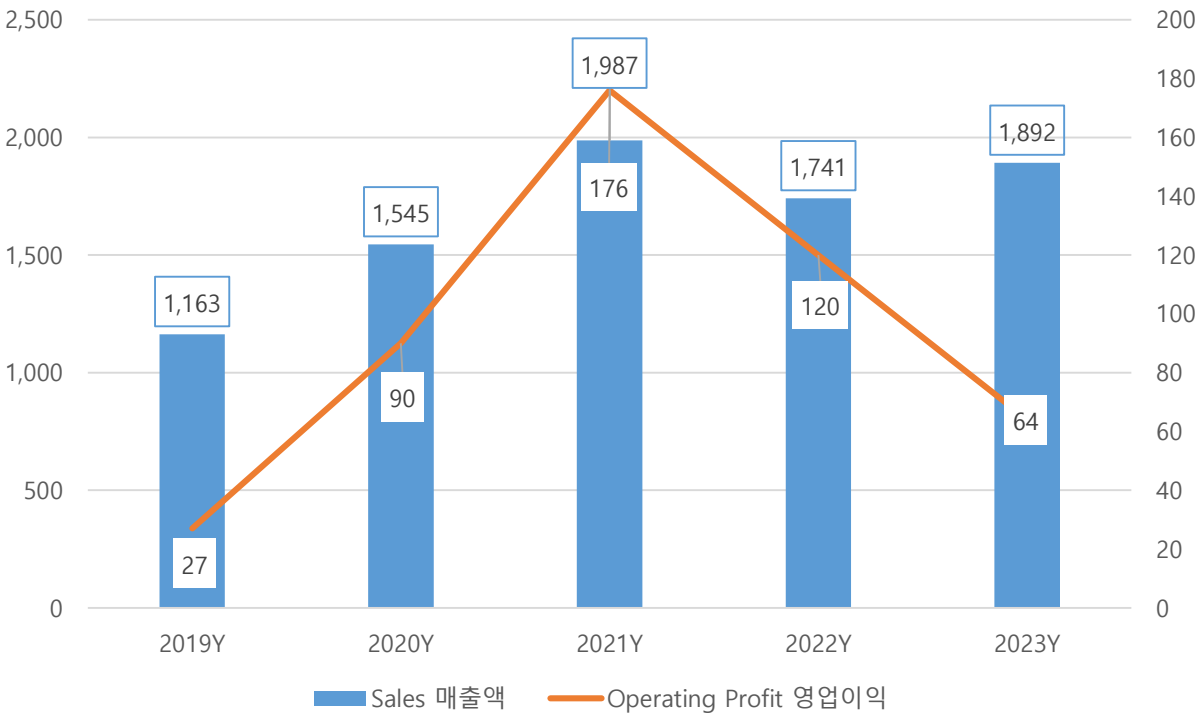
Contents

회사 개요

인류의 미래를 위한 **이차전지, 전자재료** 업계 **1등** 으로 도약합니다.

대주전자재료 5개년 실적

단위 : 억원



대주전자재료 회사 개요

설립 1981년 7월 (43년차)	상장 (KOSDAQ) 2004년 12월	CEO 임일지,임중규
매출('23) 1,892억원	DAEJOO	영업이익('23) 64억원
자본금 77억원	종업원 수 380명 현재	실리콘 음극재 중심 성장중

회사 연혁

시작

'81 회사 설립

'82 에폭시 절연재료 공급 개시

'86 고온전극재료 생산 개시

'96 상해대주 설립

'00 대만지사 설립

'01 PDP용 격벽 재료 양산 개시

'02 대한민국 10대 신기술 선정
PDP 격벽용 유리재료

'04 동관대주 설립

'04 코스닥 상장

'07 LG화학 형광체설비 인수 (CAPA 세계 2위)

'07 지경부 우수기술연구원센터지정(기상합성기술)

'08 대·중소기업 상생협력 동탑산업훈장

'09 대한민국 10대 신기술 선정
PDP용 나노분말

'10 2010년 나노코리아 기술대상
MgO 나노분말

'11 이차전지 음극재료 연구개발 start

'16 MLCC용 전극 paste 양산 개시

'16 자동차용 LED 형광체 양산 개시

'19 실리콘 음극재 양산 납품 개시

'19 특허기술대상(세종대왕상)-리튬 이차전지 음극재용 실리콘 복합산화물

'19 소재·부품·장비 강소기업 100선정

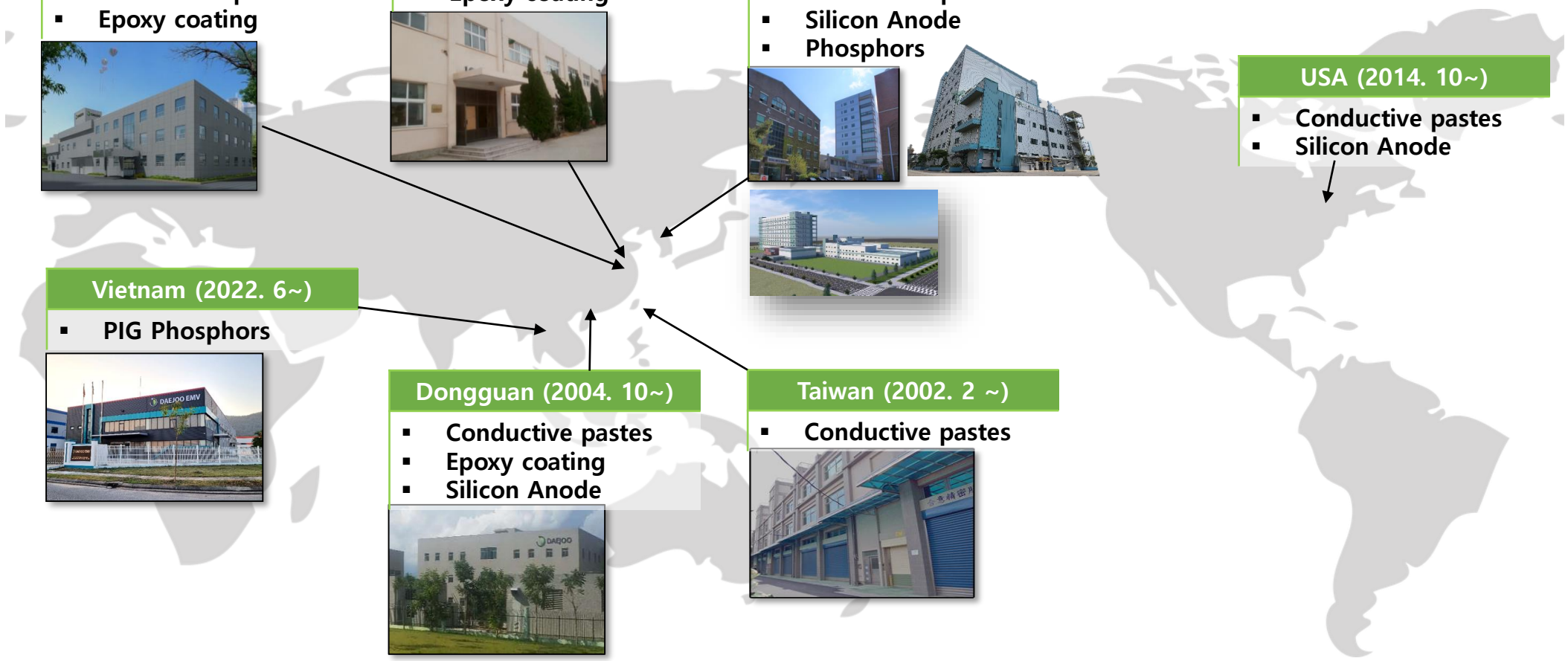
'20 실리콘 음극재 2공장 가동 개시

'22 장영실상 리튬이차전지용 실리콘산화물 음극재

'22 전지산업발전 유공 동탑산업훈장

현재

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
DAEJOO EMV
Dongguan (2004. 10~)
Conductive pastes
Epoxy coating
Silicon Anode
DAEJOO
Taiwan (2002. 2 ~)
Conductive pastes

Siheung Battery Campus(2nd Factory) for Silicon Anode Materials

Expanding capacity to meet dramatically increasing global demands

Land

	Area
Headquarter	10,925.1㎡
MTV New Factory	**46,897.4㎡**

HQ

x 4

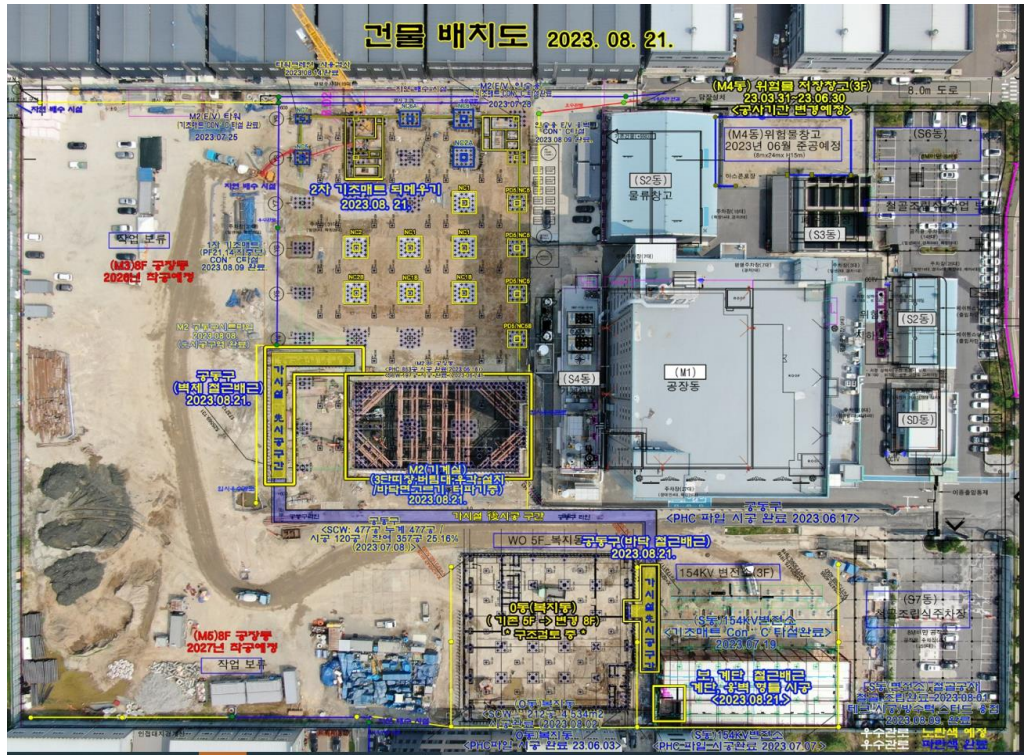
2nd Factory

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

Production Capacity Road Map (Siheung Battery Campus)

HQ (10,925.1㎡) DMSO : 300 ton/Y

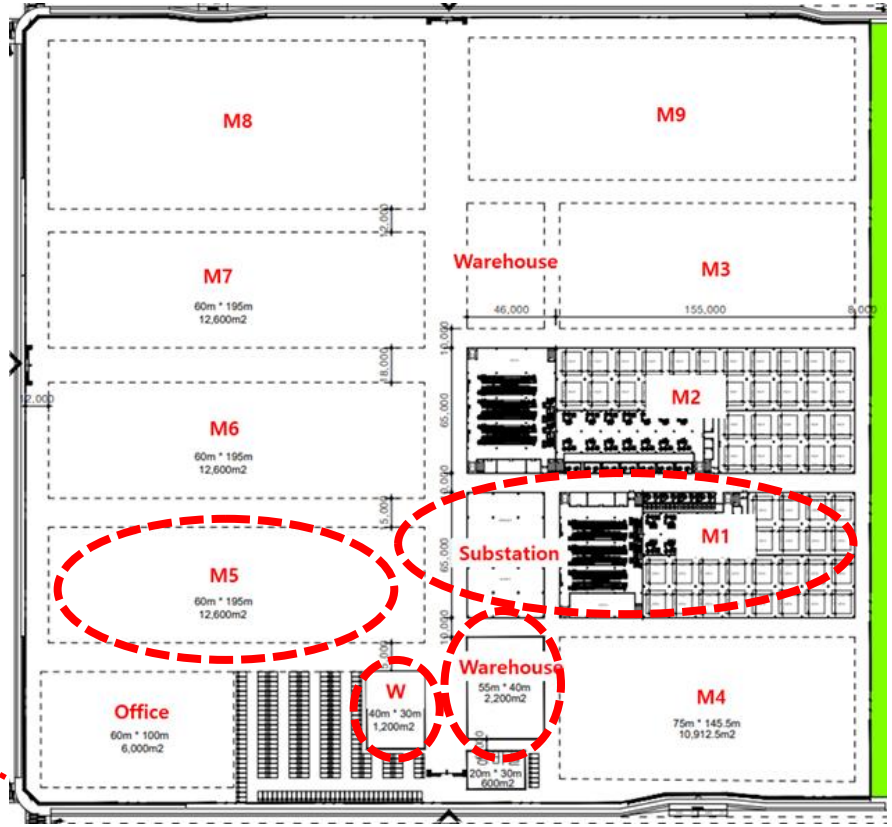
Siheung Battery Campus (2020~/ 46,897.4㎡)



Saemangeum Battery Campus(3rd Factory) for Silicon Anode Materials

Headquarters ↔ Saemangeum battery campus
(200km)

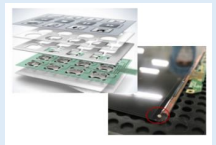
3rd Anode material Plant (2026~ / 188,100㎡)

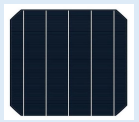


사업 분야

Conductive Paste
도전성 전극재료

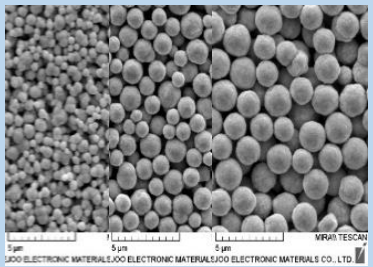
MLCC, Chip Inductor/Varistor 등 부품에 적용되는 내/외부 전극 paste로 IT 및 자동차, 산업 전장용 적용





Conductive Powder
도전성 분말

태양전지, 칩 부품 내/외부 전극용 Ag paste의 금속 Filler

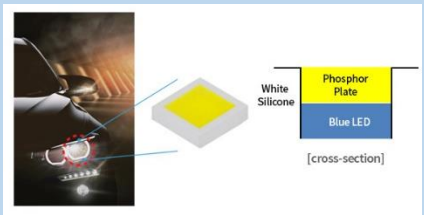


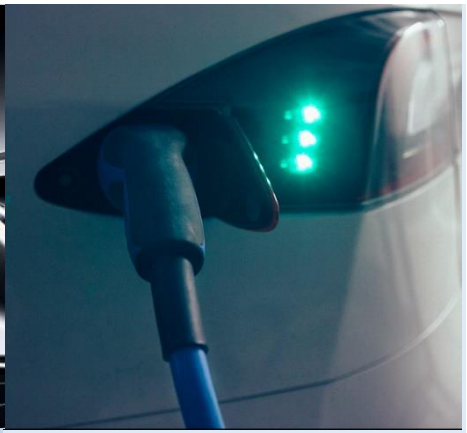
Polymer
절연

전기, 전자 절연도료의 핵심 원료인 Epoxy 수지를 이용한 화합물로 우수한 기계적 강도, 내습성, 내열성, 전기적 특성

Phosphors
형광체

광변환 효율 및 신뢰성 우수한 형광체 분말, 고온고습 신뢰성 우수한 형광 변환 플레이트





Silicon Anode
음극재

리튬이차전지의 음극활물질로, 탄소계 음극활물질의 용량(350mAh/g) 대비 고용량(1300~1700mAh/g)을 갖는 실리콘계 음극활물질

Conductive Paste 도전성 전극재료

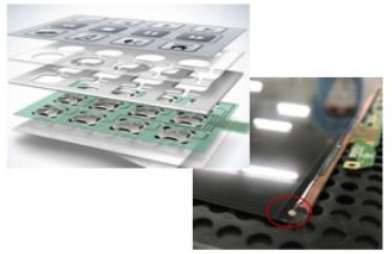
MLCC, Chip Inductor/Varistor 등 부품에 적용되는 내/외부 전극 paste로
IT, 가전 및 전장용 적용

제품

전극 paste

적용부품

칩부품
(MLCC)



전자부품
(멤브레인스위치, 정전기방지)

전자부품
(세라믹 콘덴서, 바리스터)

태양전지

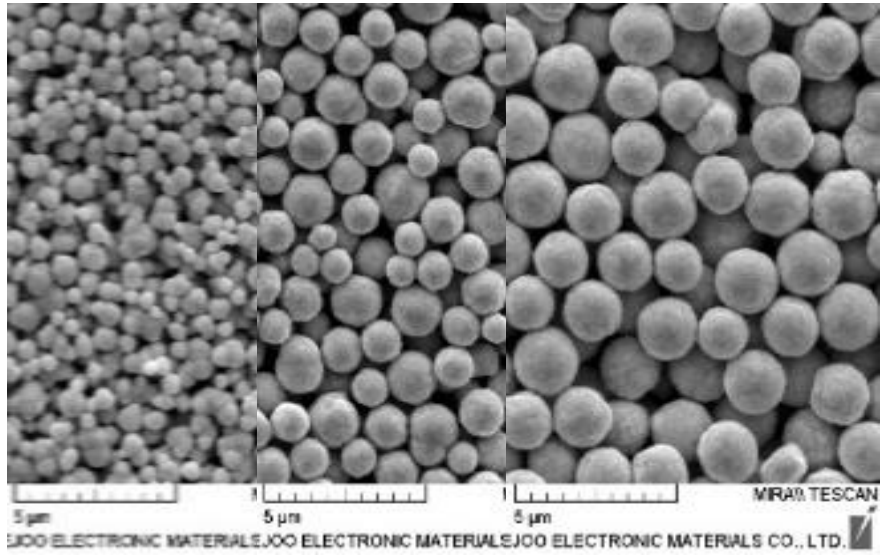
주요 고객
: 삼성전기, 한화솔루션, 파트론, 아모텍, Walsin 등

Conductive Powder 도전성 분말

태양전지, 칩 부품 내/외부 전극용 Ag paste의 금속 Filler

제품

전극용 Powder



적용품

내/외부전극, 저온 경화형 페이스트

주요 고객

: 당사 제품의 재료로 사용 중. 세계 유일하게 도전성 분말을 내재화.

Polymer 절연

전기, 전자 절연도료의 핵심 원료인 Epoxy 수지를 이용한 화합물로 우수한 기계적 강도, 내습성, 내열성, 전기적 특성

제품

고상 epoxy

액상 epoxy

주요 고객
: 아비코전자, 우리산업, 광전자 등

적용부품

수동부품(L·R·C, Varistor 등)

차량용 필드코일
(제품 적용 전)

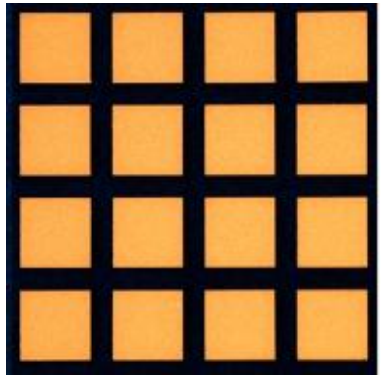
차량용 필드코일
(제품 적용 후)

Phosphor 형광체

광변환 효율 및 신뢰성 우수한 형광체 분말,
고온고습에 신뢰성 우수한 형광 변환 플레이트

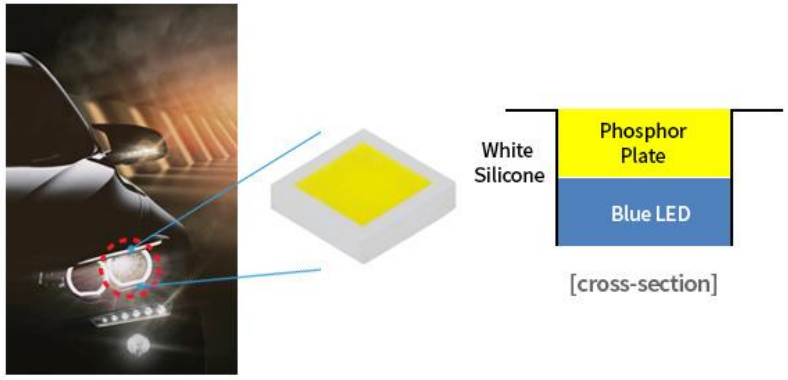
제품

형광체 & 형광 변환 플레이트(Phosphor Plate)



적용부품

LED조명, 자동차용 LED



주요 고객
: 서울반도체, 삼성전자, Everlight 등

주요 고객사


LG Energy Solution


SK on


SAMSUNG
SAMSUNG SDI


Panasonic


VinES


acc
AUTOMOTIVE CELLS Co
ACCELERATING
SUSTAINABLE
MOBILITY
FOR ALL


MORROW


EVE 亿纬锂能


TENPOWER


northvolt


SAMSUNG
SAMSUNG ELECTRONICS


SAMSUNG
SAMSUNG
ELECTRO-MECHANICS


SEOUL
SEOUL SEMICONDUCTOR


HUAWEI


HYUNDAI
ENERGY SOLUTIONS


Hanwha Q CELLS


EVERLIGHT


TDK


VISHAY


CHILISIN

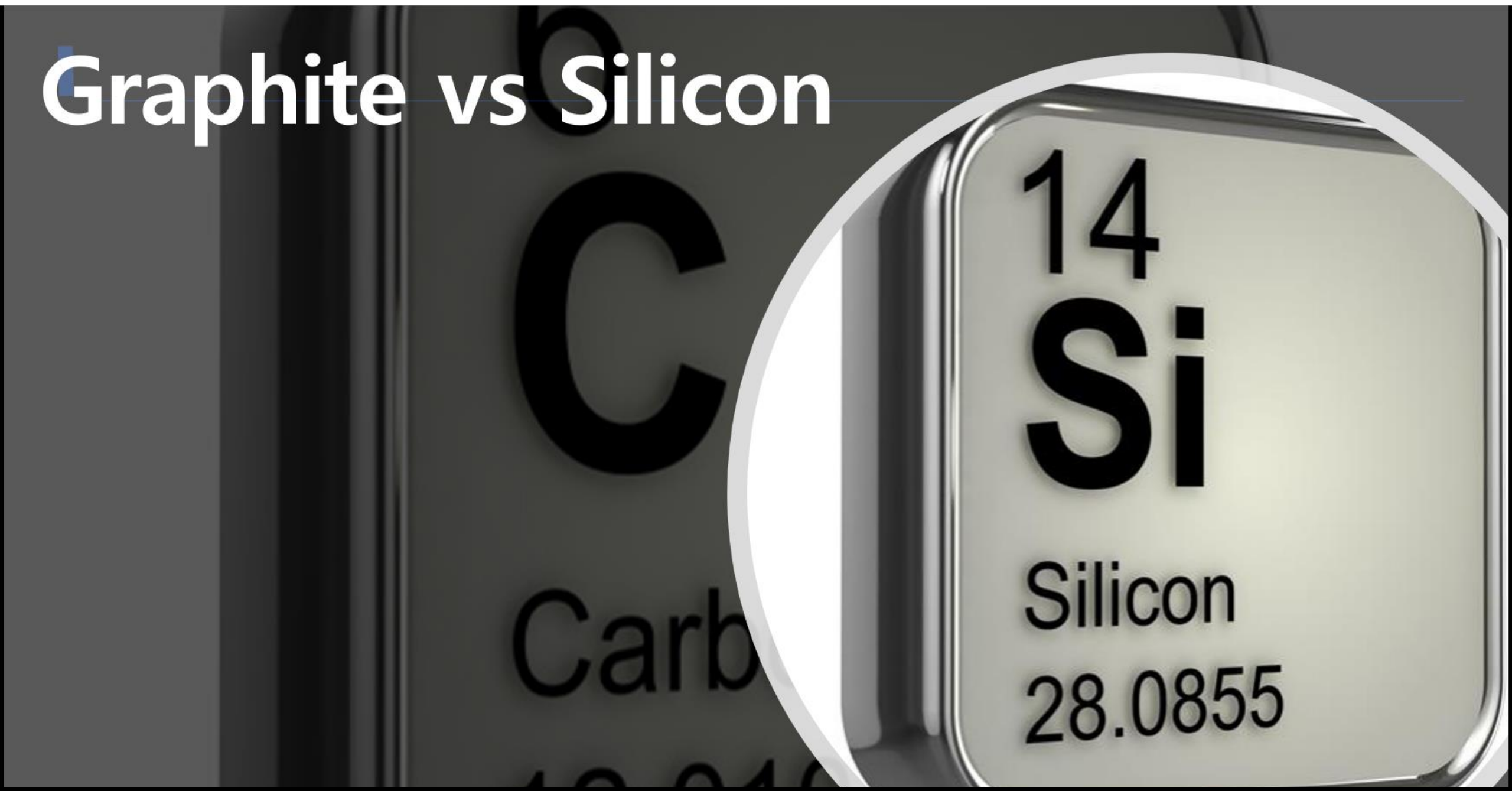
제품별 매출

(단위 : 억원)

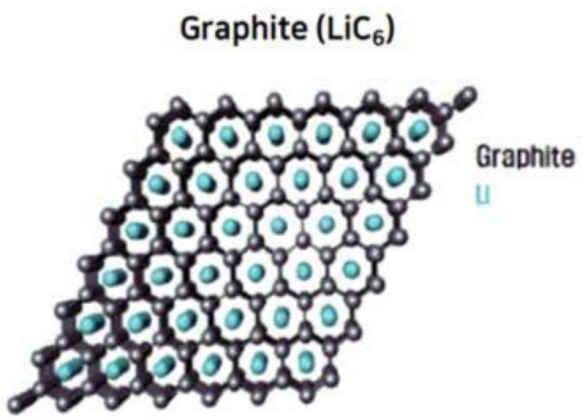
구분		2018	2019	2020	2021	2022	2023
전도성	칩	320	426	400	580	526	**440**
	태양전지	50	101	134	160	176	**189**
	MLCC	300	298	430	580	311	**379**
	합계	670	825	964	1,320	1,013	**1,008**
절연		160	122	194	269	263	**209**
형광체	일반	57	25	17	10	6	**6**
	자동차용	110	121	140	145	173	**280**
	합계	157	146	157	155	179	**286**
리튬이온배터리용 실리콘음극재			37	130	210	266	**235**
기타		43	34	100	33	20	**154**
총 합계		1,030	1,164	1,545	1,987	1,741	**1,892**

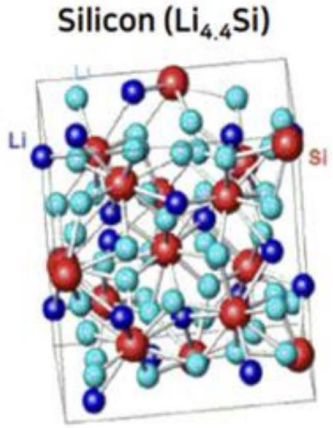
Contents

Graphite vs Silicon



Problems of silicon-based anode material

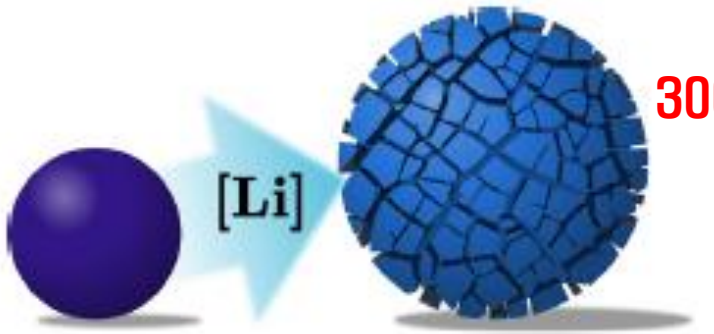




Volume change during charging and discharging

-> *Fracture and breakage of Si-based anode*

-> *Formation of unstable SEI, degradation of electrode*

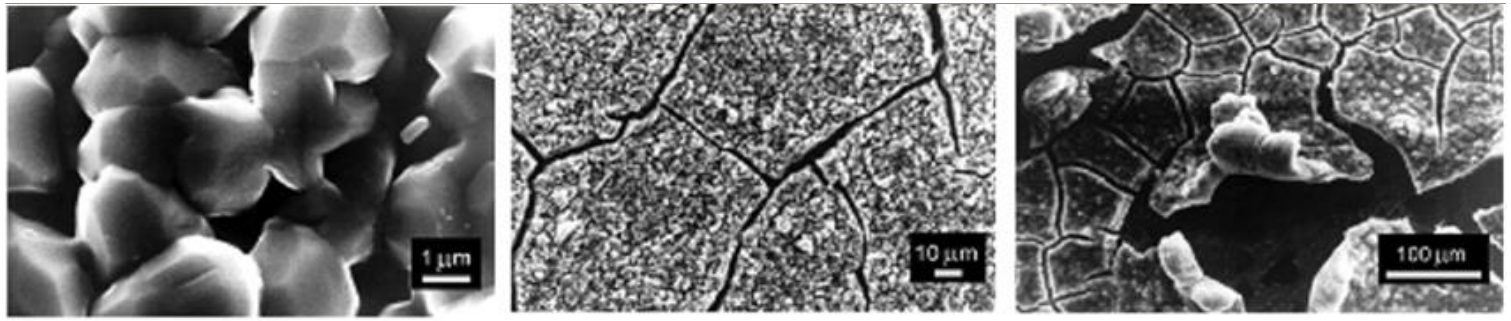


300% 부피팽창

High charge / discharge capacity

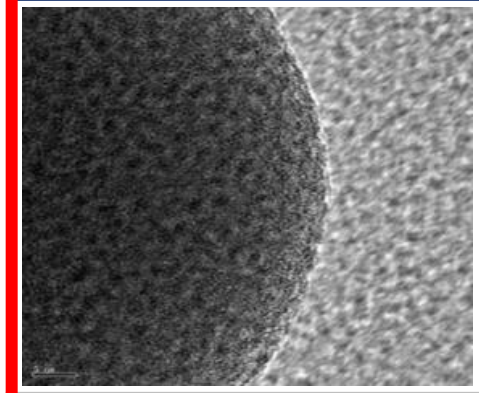
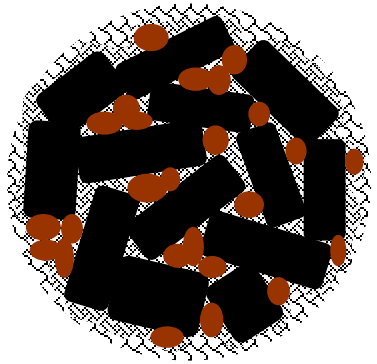
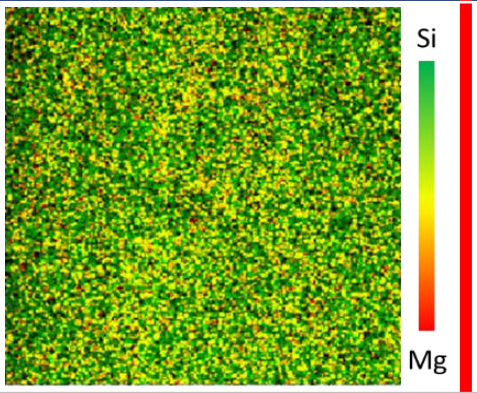
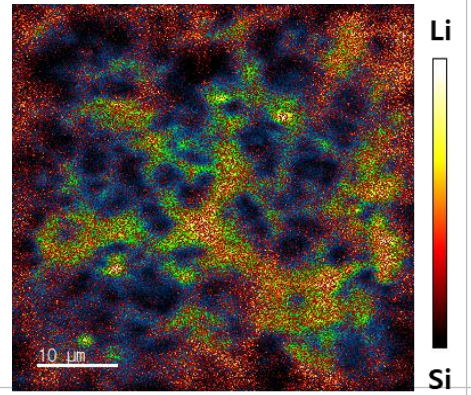
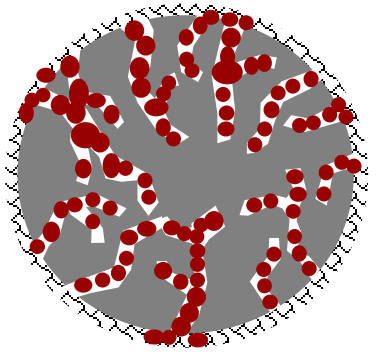
Li + 6C => LiC_6 (372mAh/g)

4.4Li + Si => $Li_{4.4}Si$ (4200mAh/g)

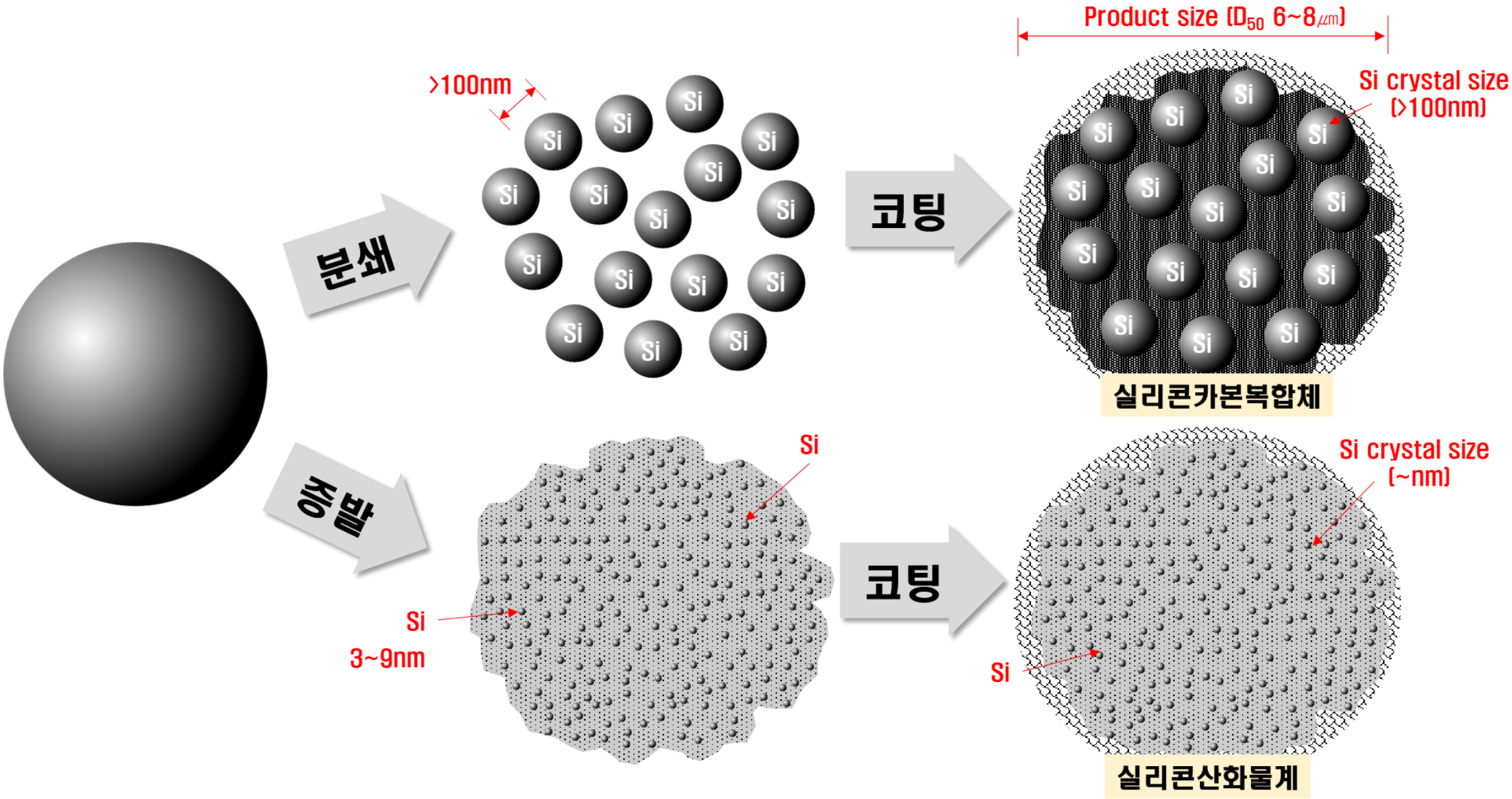


Ref) Bruno Scrosati and Jurgen Garche, Journal of Power Sources, 195 (2010) 2419.

The technologies of silicon anode materials

SiOx composite	Si/C composite	Mg doped SiOx composite	Li doped SiOx composite	Next generation
				
Daejoo ShinEtsu Chemical BTR New Energy	BTR New Energy	Daejoo	ShinEtsu Chemical	Daejoo 등
수nm 크기의 Si이 SiO_2와 삼차원적으로 균일한 화학적 결합	수십nm 크기의 Si이 흑연과 물리적으로 혼합	수nm 크기의 Si이 SiO2, 마그네슘 실리케이트 들과 삼차원적으로 균일하게 분포된 구조	수nm 크기의 Si이 SiO2, 리튬 실리케이트 들과 삼차원적으로 균일하게 분포된 구조	다공성 카본내에 수nm의 Si을 삽입한 구조 (R&D stage or Pilot scaled)

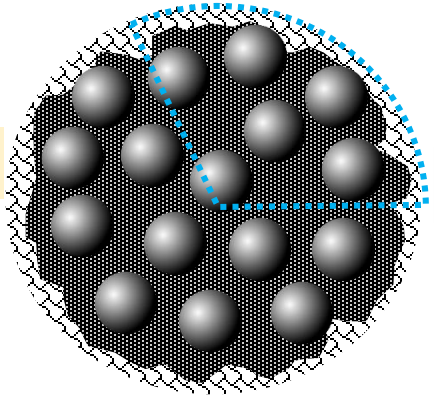
The commercialized silicon anode materials (SiC vs SiOx)



Expansion of silicon materials

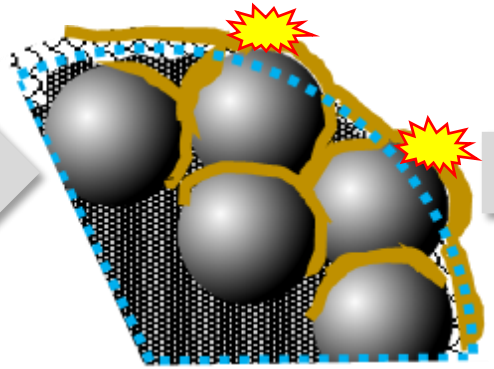
Swelling = expansion of Si + side reaction with EL

실리콘카본복합체



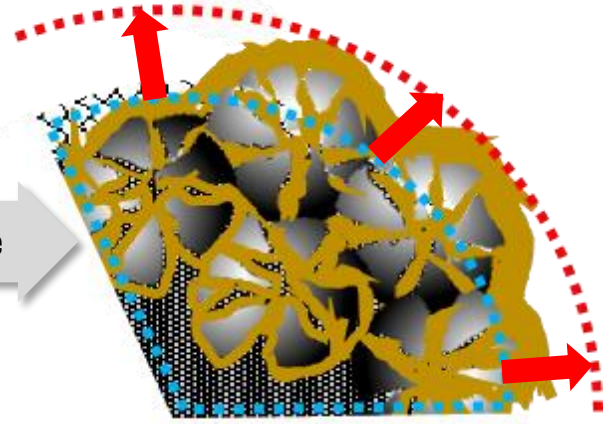
Charging

Si ↔ EL



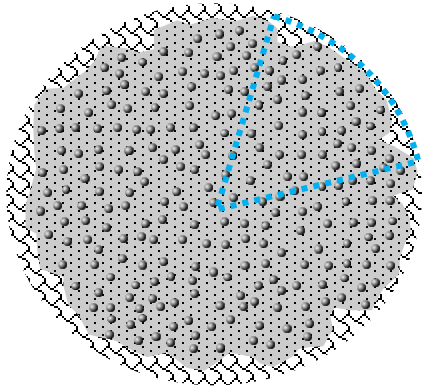
Expansion → Surface area ↑

Cycle

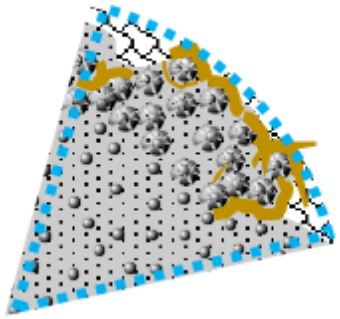


Expansion & Contraction
→ pulverization of Si
→ Surface area ↑

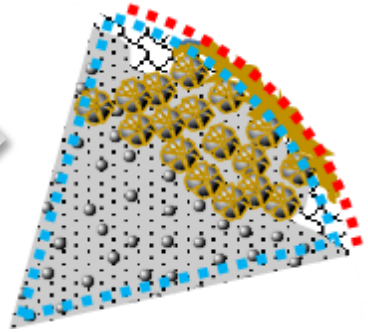
실리콘산화물계



Charging



Cycle



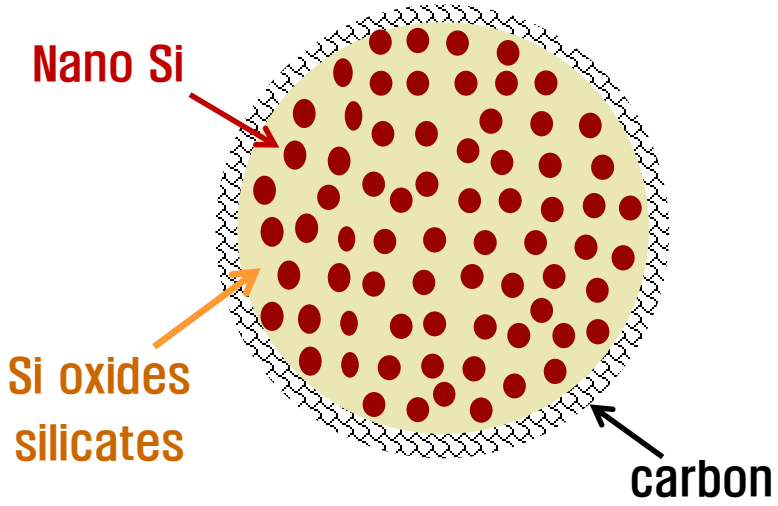
The pulverization of Si by expansion and contraction occurs almost inside the matrix.

The development concept of advanced silicon anode material

실리콘 사이즈는 극단적으로 작게, 실리콘 표면에서의 부반응을 억제하는 구조

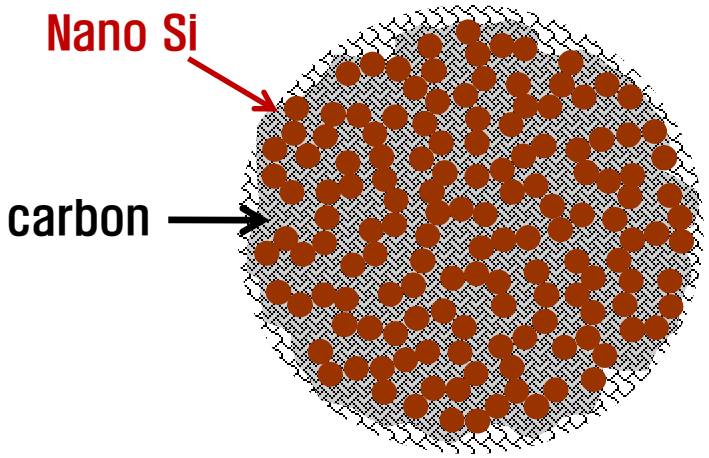
① Si crystal size < 7nm ② Structure : silicons do not contact with electrolyte directly

Si oxide composites



<시장 확대 중>
양산성, 가격경쟁력 확보

porous Si / carbon



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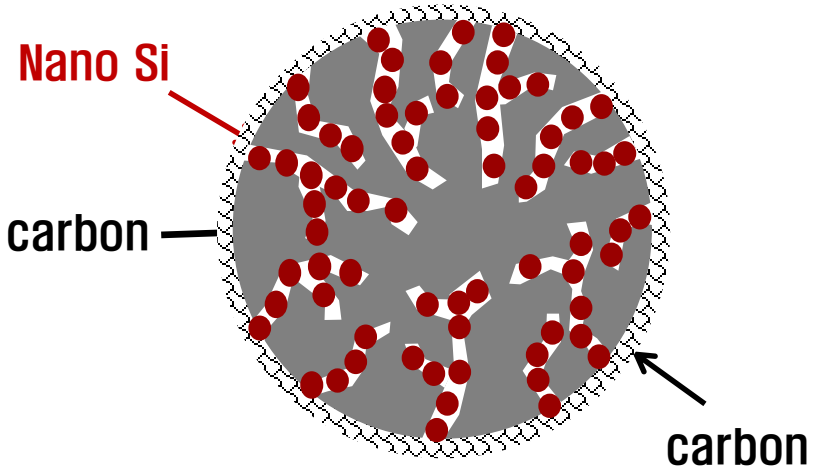
Si / porous carbon

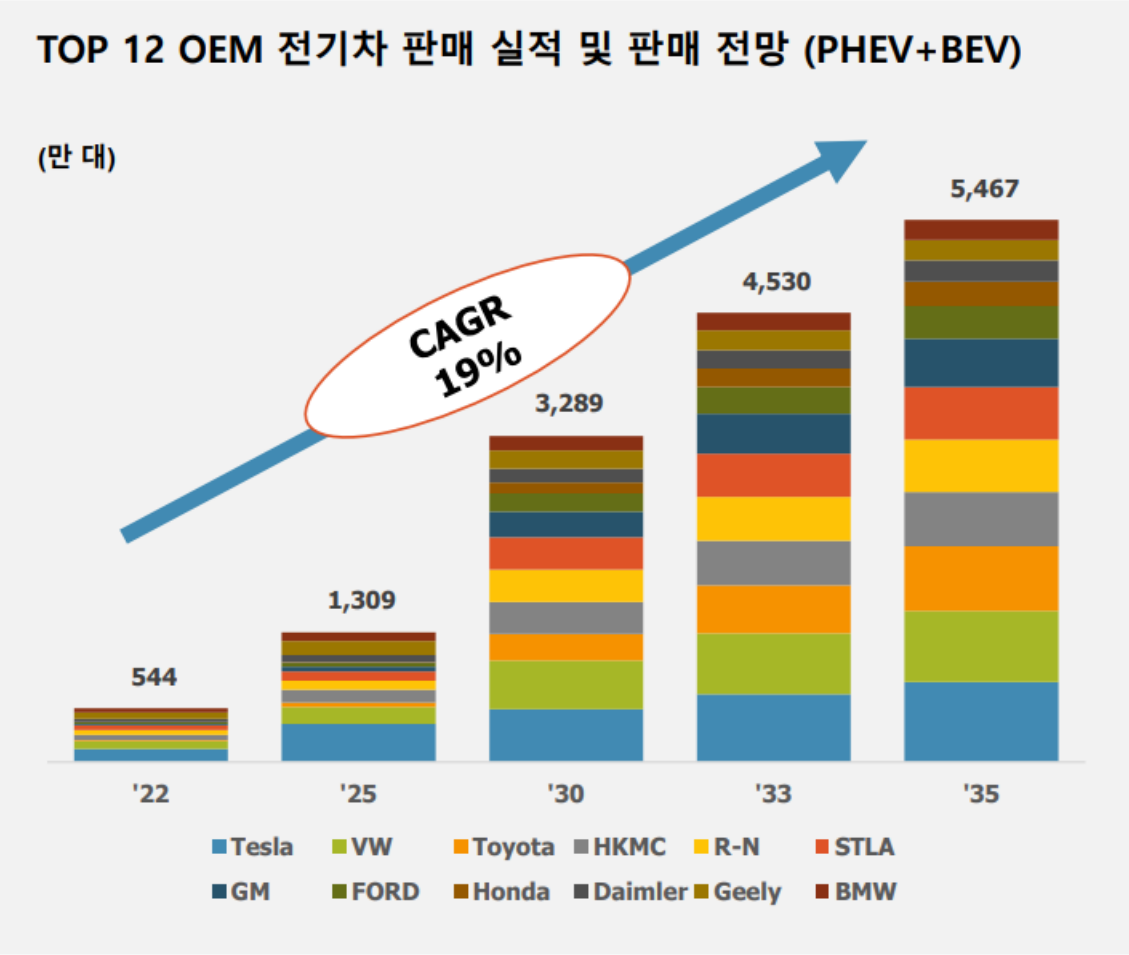


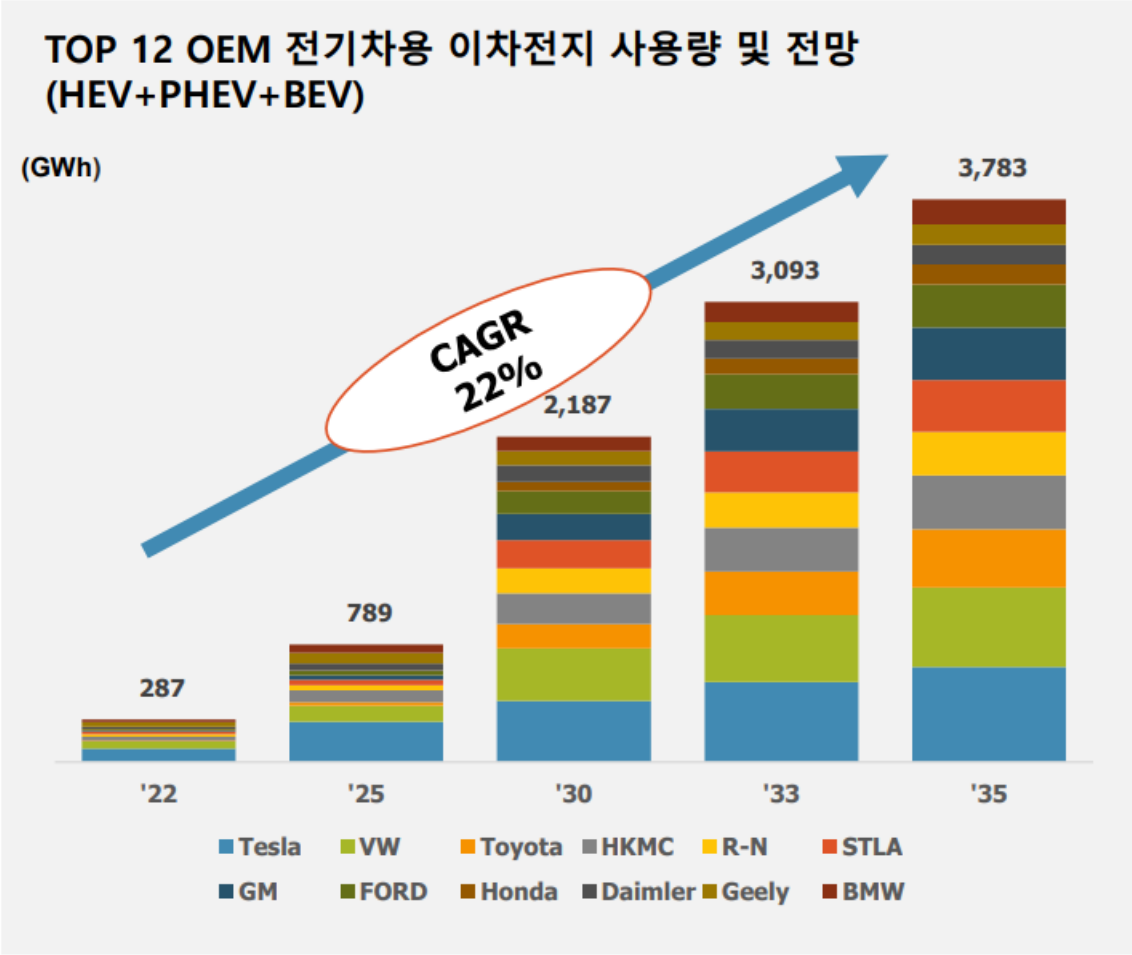
<R&D 단계>

Contents

EV Market Trend and Outlook

- Top 12 OEM 전기차 판매량은 2030년 3,290만대에 달할 것으로 전망
- 이차전지 수요는 2030년 약 2,190GWh에 달하며, OEM별 비중으로는 테슬라가 가장 많은 차량 판매 및 이차전지 사용량을 기록할 것



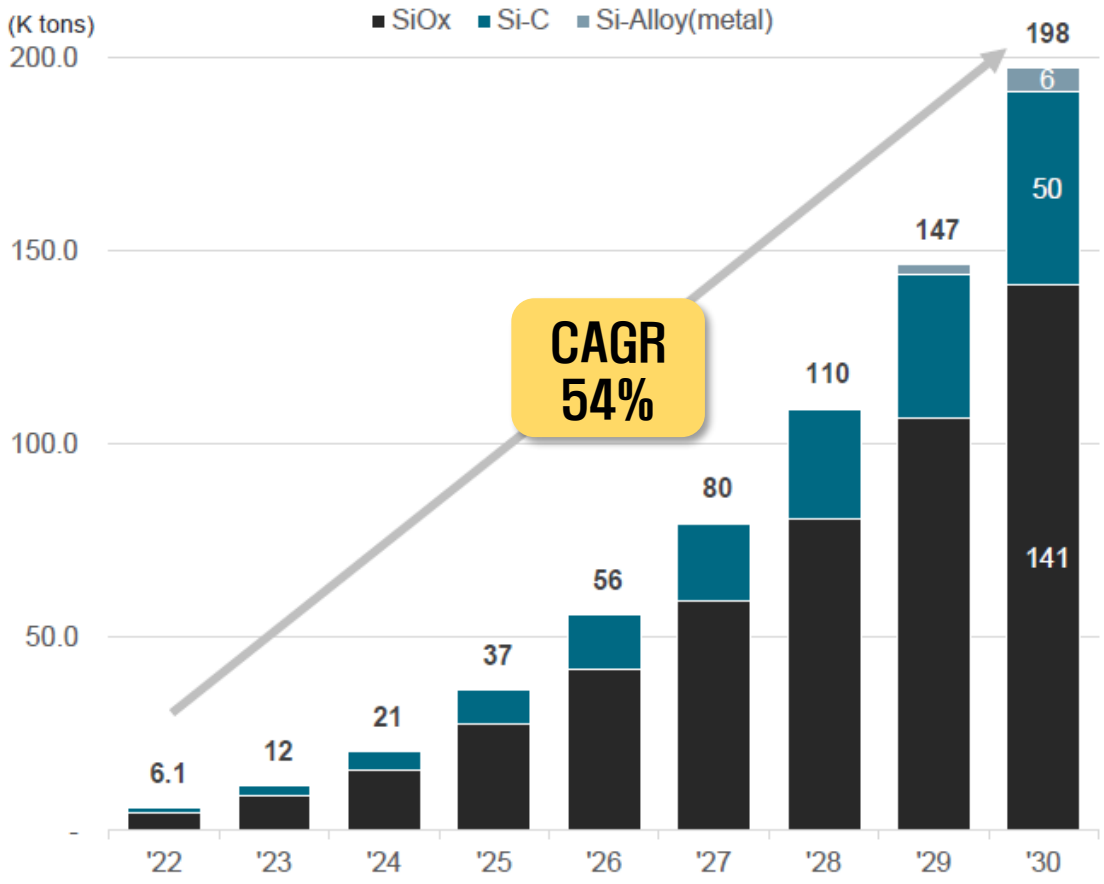


Source: <2023.1H>Global 자동차 OEM별 Battery 수급전망 (~2035년)

Silicon Anode Market Trend and Outlook

Silicon Anode Will Grow Rapidly With The Growth Of EV Batteries

Global silicon anode market outlook



Source: SNE Research

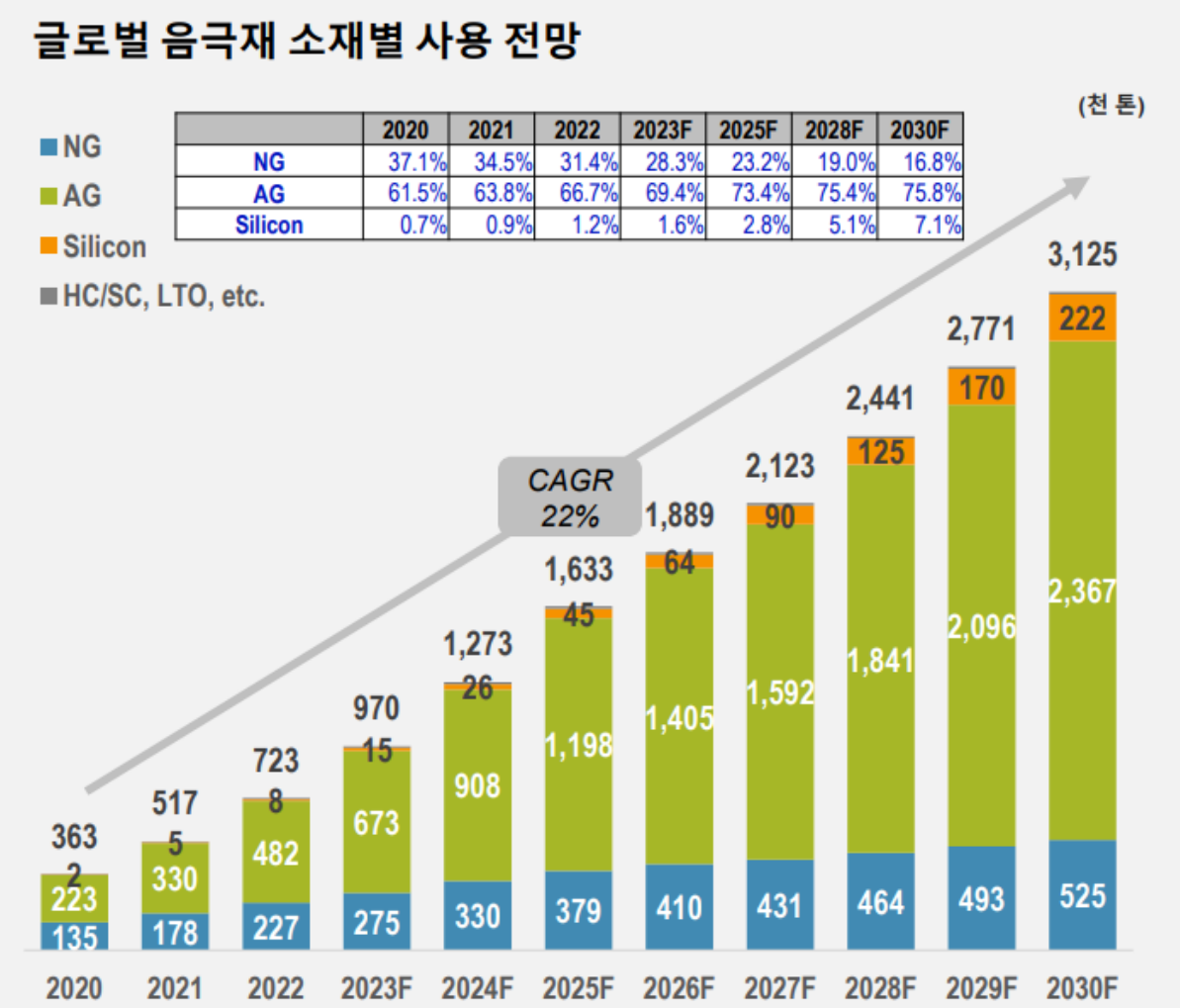
Supply Chain Is Being Formed

Silicon adoption status of battery makers by type

Type	Battery Makers	Silicon Suppliers
SiOx	• LGES • CATL • Panasonic • SK on • BYD • Lishen • …	• Daejoo • Shinesu • BTR • Shanshan • Osaka Titan • …
Si-C	• SDI • SK on • BAK • ATL • …	• Shanshan • BTR • Group 14 • Nexeon • Wacker • LPN • NEO Battery • Hansol • …
Si metal/alloy	• Tesla • …	• Sila Nano • Enovix • Enevate • Leyden Jar • …

Source: SNE Research

Silicon Anode Market Trend and Outlook



	2020	2021	2022	2023F	2025F	2028F	2030F
NG	37.1%	34.5%	31.4%	28.3%	23.2%	19.0%	16.8%
AG	61.5%	63.8%	66.7%	69.4%	73.4%	75.4%	75.8%
Silicon	0.7%	0.9%	1.2%	1.6%	2.8%	5.1%	7.1%

Source : SNE Research 2023 3Q new forecast

The performance of EV and silicon anode materials

- 최근 10년간 EV 시장은 에너지밀도를 높이는 방향을 중심으로 기술 발전
- EV 시장의 driving force는 에너지밀도 보다 **급속충전 성능의 확보**가 주가 될것으로 예상

Fast Charging	>1 hr	~40 min	~22 min	~18 min	~10 min
Mileage	~ 150 km	150 ~ 500 km	350~800 km		
Energy Density	~200 Wh/kg	200~ 300 Wh/kg	250~400 Wh/kg		
Battery Capacity	~ 30 kWh	30 ~ 100 kWh	60~130 kWh 이상		
Cell Price	$200~1000/kWh	$100~250/kWh	$60~130/kWh		
Anode Material	Gr. only	Gr. + SiO(~5wt%)	Gr. + SiO(~30wt%)		

2010 2015 2020 2025 2030

Silicon Anode Market Trend And Outlook

- *실리콘음극재는 전기차용 배터리의 에너지밀도와 급속충전 성능을 개선하기 위하여 시장에서 사용량이 계속 증가할 것*
- *2030년까지 전체 음극 사용량의 26%까지 증가할 것으로 예상*

The Effect Of Silicon Anode

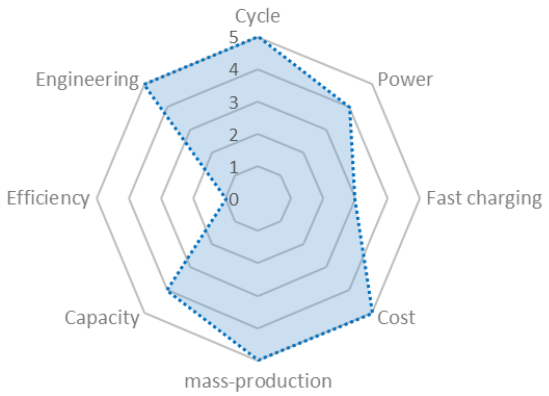
Estimation of cell performance change according to material change

Item		Details	BEV (2020)	BEV (2023)
Material Change	Cathode	Active Material	NCM622	High-Ni NCM
		Conductor	Carbon Black	CNT
		Binder	PVDF	PVDF
		Foil(Al)	Al Foil	Al Foil
	Anode	Active Material	AG(90)+NG(10)	AG(95)+**Si(5)**
		Conductor	Carbon Black	CNT
		Binder	SBR, CMC	SBR, CMC
		Foil(Cu)	Cu Foil(8um)	Cu Foil(6um)
Performance Change		Energy Density	266Wh/kg 600Wh/L	**+25%** (compared to 2020)
		Fast Charging	SOC 8~80%, 30min	**+50%** (compared to 2020)

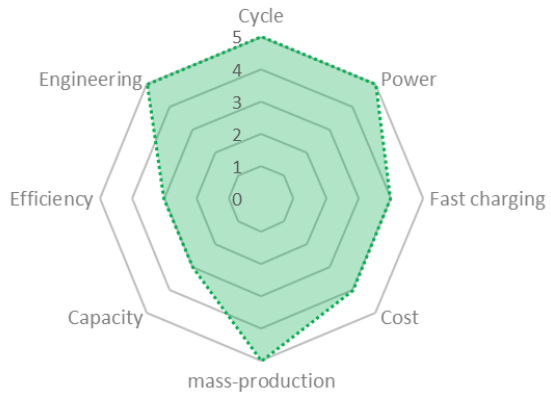
Source: SNE Research

Comparison of silicon materials

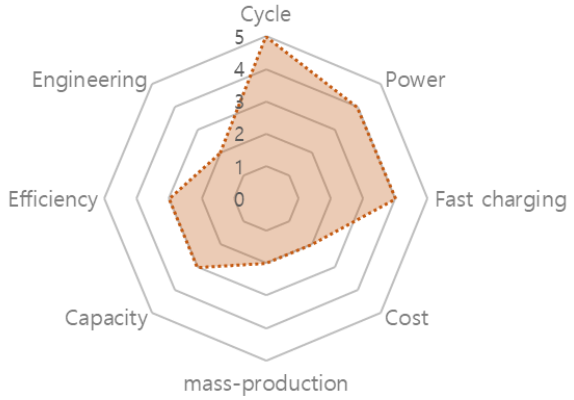
SiOx



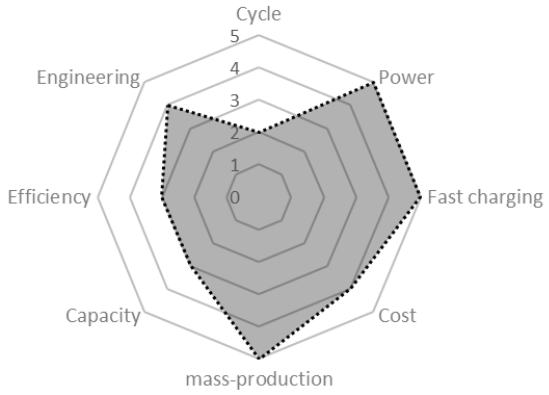
DMSO



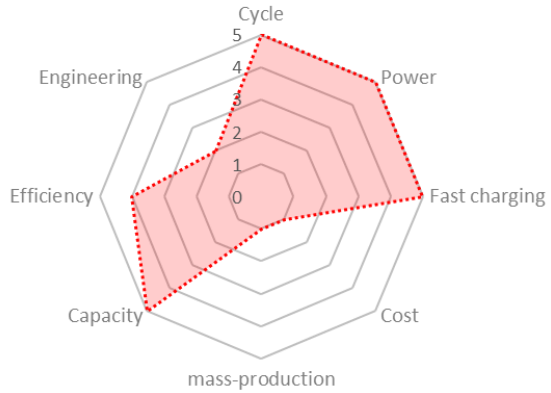
Li-SiOx



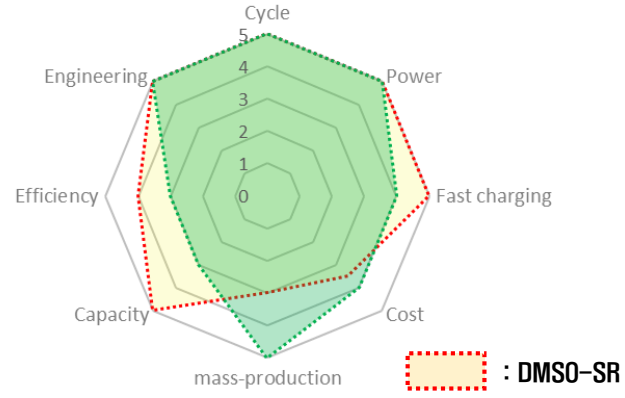
Si/C



nano Si/C



DMSO vs DMSO-SR



Thank you

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