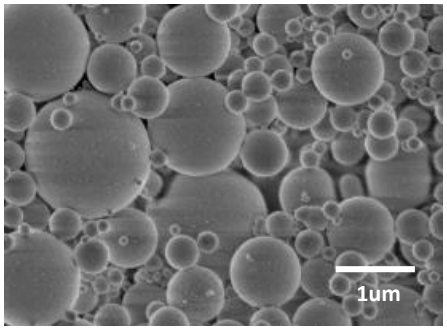
2/28/2018
Admatechs Co., Ltd
R&D Division

Admatechs Technical Overview

Admatechs Co., Ltd.

Contents

1. Company Profile



1. Company Profile

Overview of Operation

Established February 1990

(History)

July	1994	New plant constructed (within TMC's Myochi Plant)
June	1996	National Commendation for Invention (awarded the Prime Minister Prize)
August	1999	Acquired ISO 9002 certification by the International Organization for Standardization (ISO)
October	1999	Established system with production capacity of 300 tons per month
May	2000	Construction of Technical Center (adjacent to TMC's biotechnology research institute)
October	2001	Relocation of Head Office (from Tokyo to the Technical Center)
October	2002	Acquired ISO 9001:2000 certification

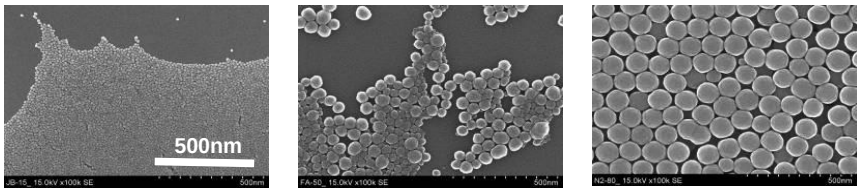
Capital 300 million yen : Toyota Motor Corporation 52.9%, Shin-Etsu Chemical Co., Ltd. 25.6%, Shin-Etsu Quartz Products Co., Ltd.15.4%, Other 6.1%

Business activities Manufacture and sale of oxide ceramic powders (silica, alumina, and composite oxides)

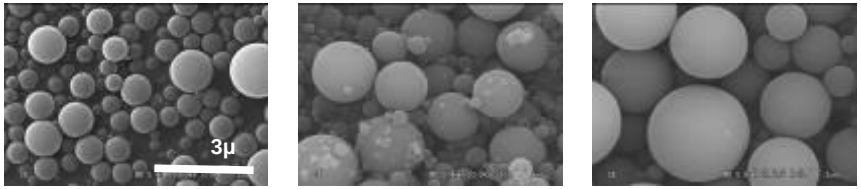
Location Aichi Prefecture, Japan

President Susumu Abe

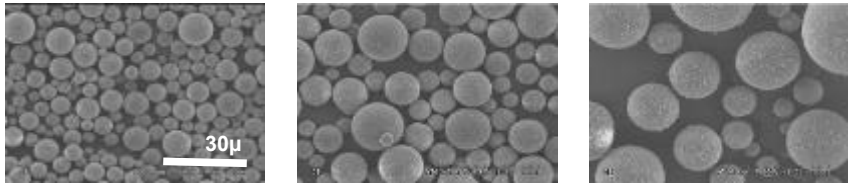
1-1. Admatechs Product Line Up



application



application



1 nm | 10 nm | 100 nm | 1000 nm (1μm) | 10μm | 100μm

Admanano

Nano sized silica
10 nm～100 nm
High Performance Nano Composite

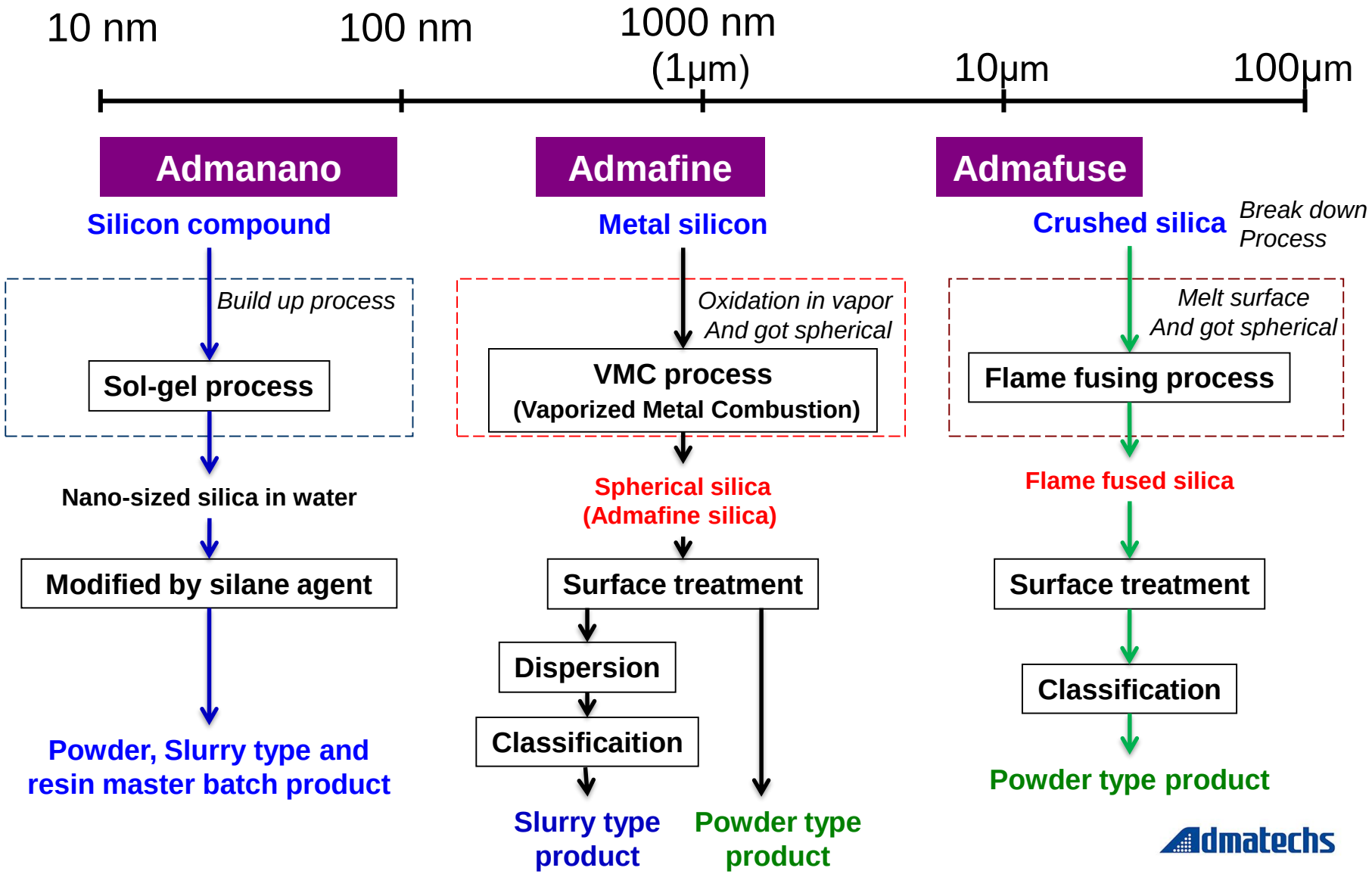
Admafine

VMC silica
0.2 μm～2.0 μm
Liquid encapsulation, sub-particles for EMC

Admafuse

Flame fused spherical silica
5 μm～30μm
Main particles for EMC

1-1. Process Flow of Admatechs Products

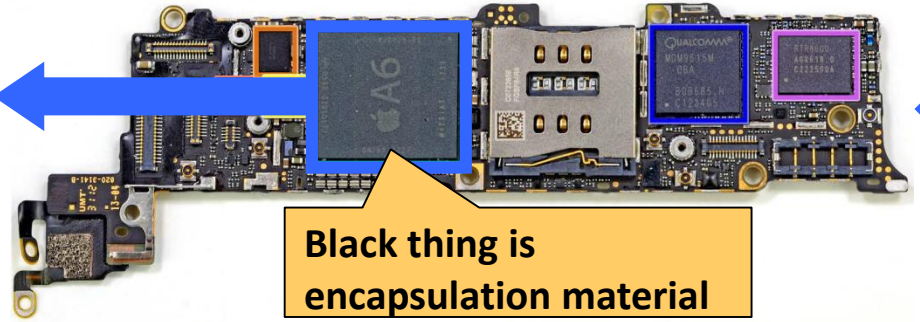


1-1. Application Example of Admatechs Products

Electronic Device

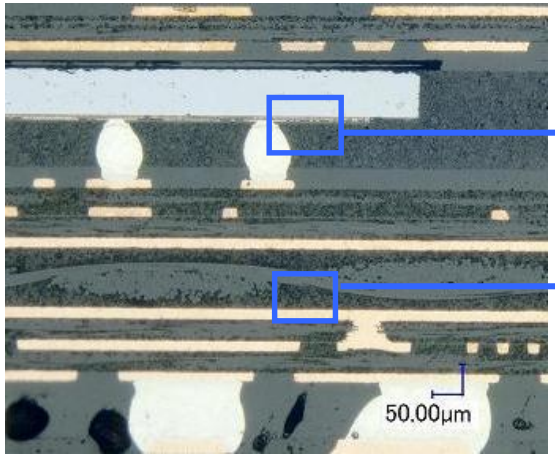
A6 : Application Processer

Cross Section



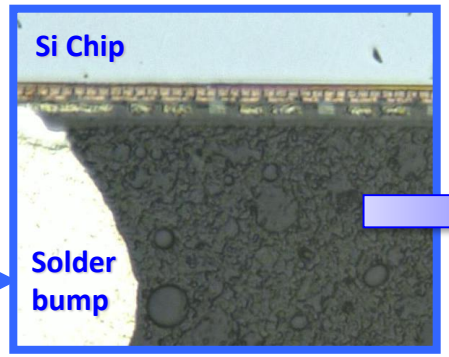
Black thing is encapsulation material

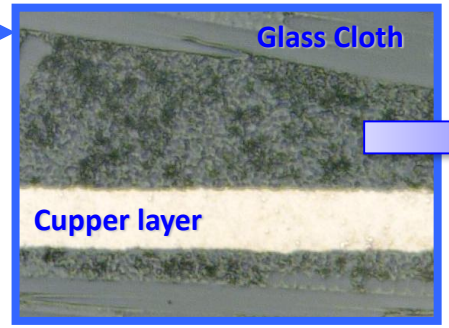
iPhone



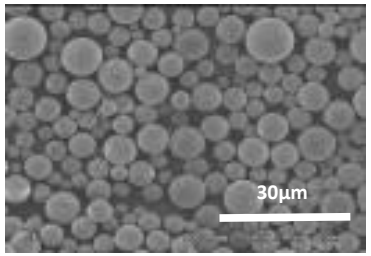
Mold Under Fill

Substrate layer

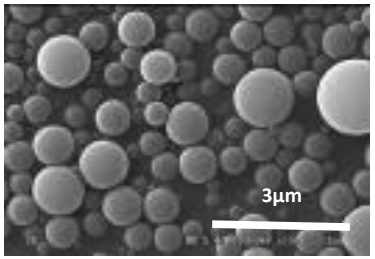




Admafuse : 5um silica



Admafine : 0.5um silica



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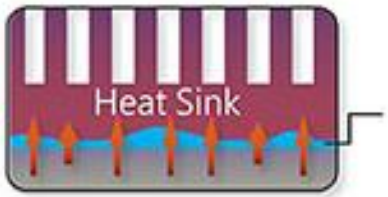
1-1. Application Example of Admatechs Products

Thermal Interface Material

Schematic representation of two surfaces in contact and heat flow across the interface.

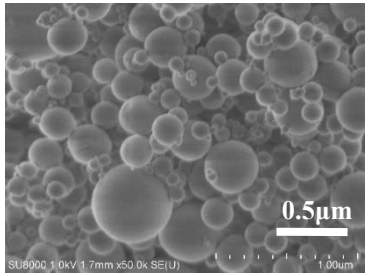


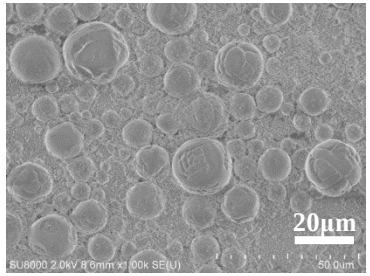
Interface material compressed between two contacting surfaces.

Thermally Conductive Sheet

Thermally Conductive Grease

Admafine Alumina : 0.2um, 10um





- **High Thermal Conductivity.**
- **Low Viscosity, High Flexibility.**

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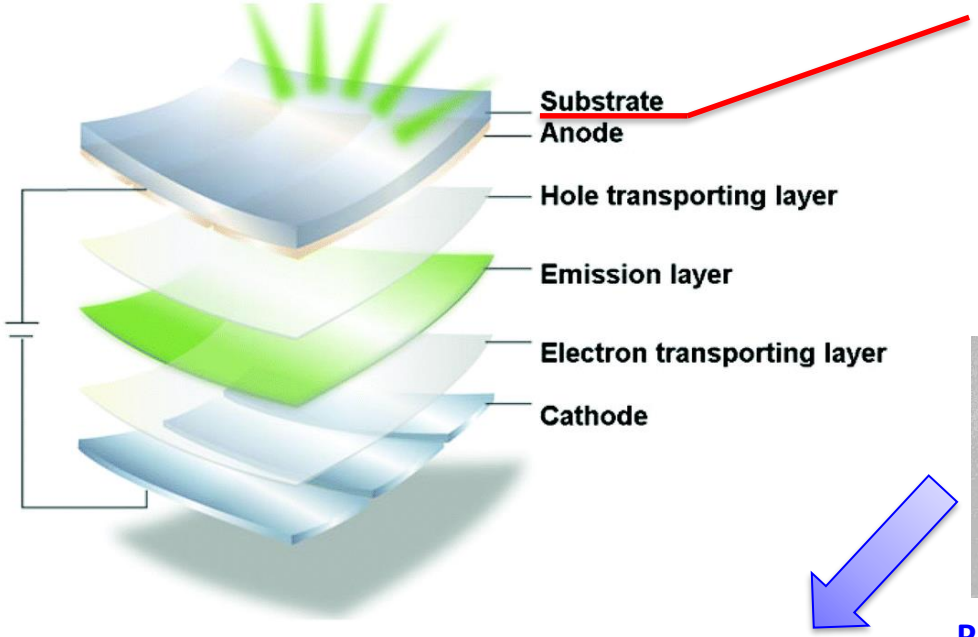
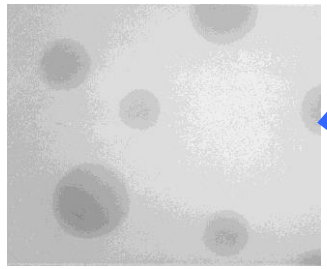
1-1. Application Example of Admatechs Products

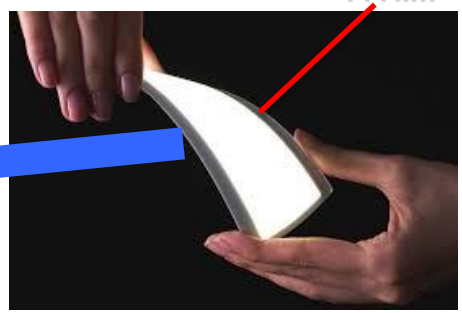
OLED



Glass Substrate (Traditional Rigid Substrate)

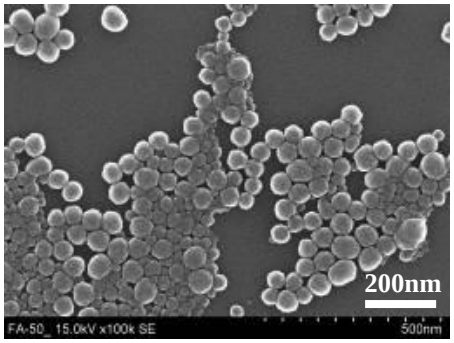
PI Film (Flexible Transparency Substrate)





PI Film, Cross Section Image

Admanano : 50nm silica



- Reduce CTE, improve physical properties
- High Transparency due to nano size and no agglomeration.

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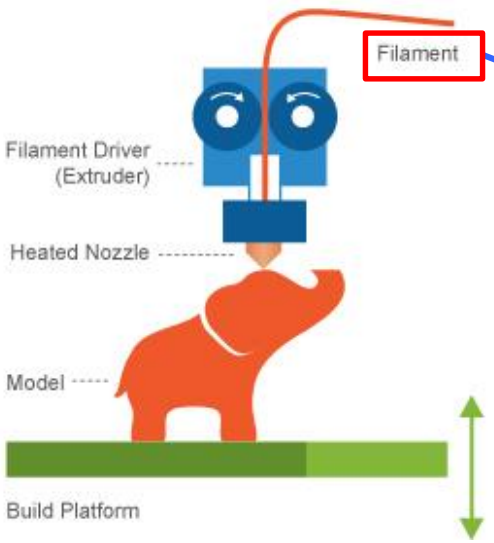
1-1. Application Example of Admatechs Products

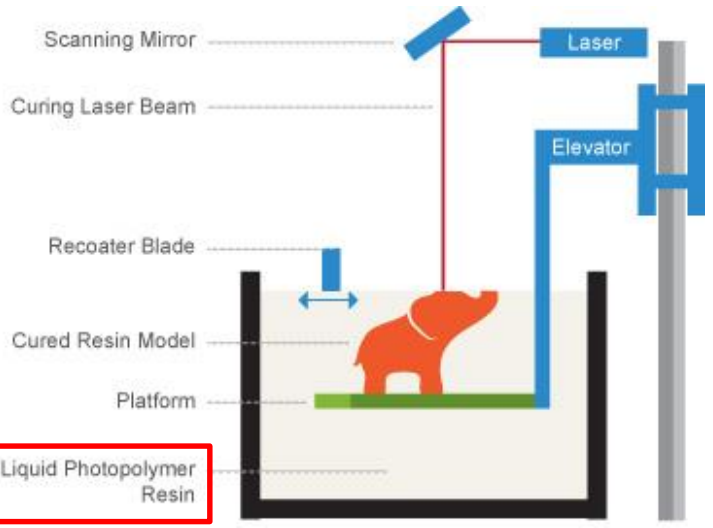
3D Printer

Fused Deposition Modeling (FDM)



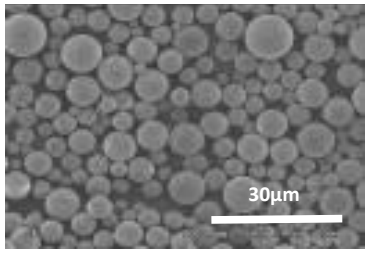
ABS, PLA,
Other resin

Stereo lithography (SLA)

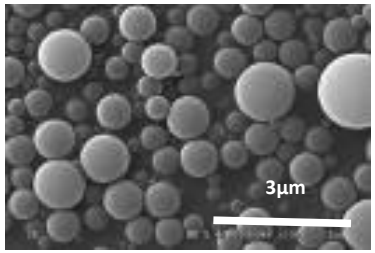


Acryl,
Other Resin

Admafuse : 5um silica



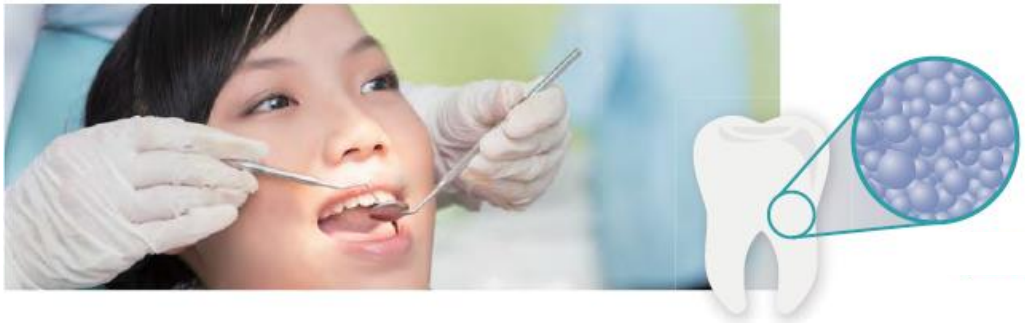
Admafine : 0.5um silica



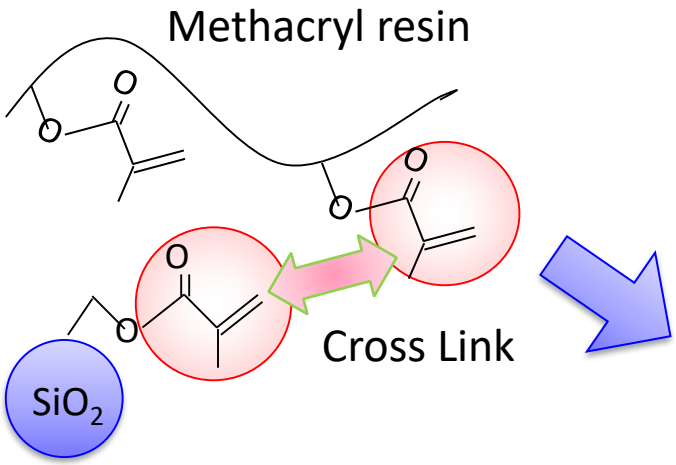
- **Low Viscosity.**
- **Reduce CTE,**
  Improve physical properties.

1-1. Application Example of Admatechs Products

Dental Composite

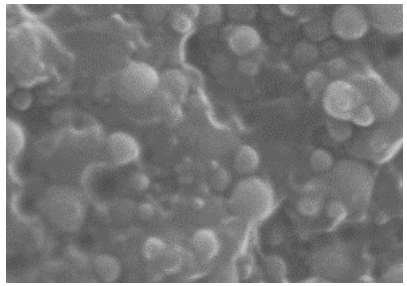


- **Uniformly surface treated nano silica.**
- **Uniform Dispersion into Methacryl Resin Composite.**
- **Improve Flexure Toughness with Good Esthetics.**



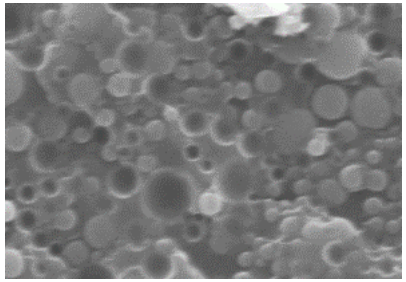
Methacryl treated
Admanano silica

Admanano Silica



Good Compatibility

Ref.. Ordinary silica

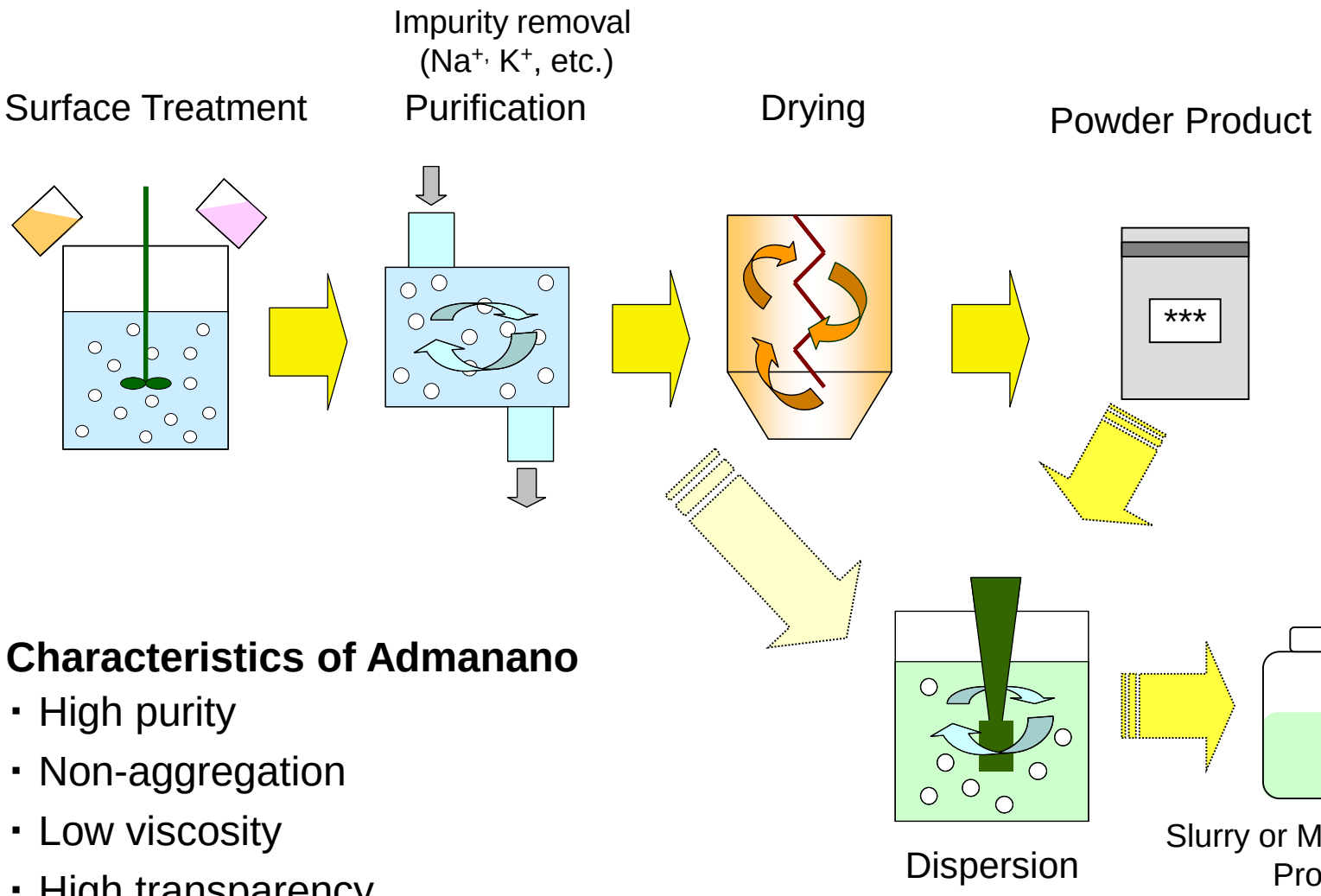


Bad Compatibility..

Admatechs

1-2. Various Size Spherical Silica, Alumina

Admanano Manufacturing Process (10 – 100nm)



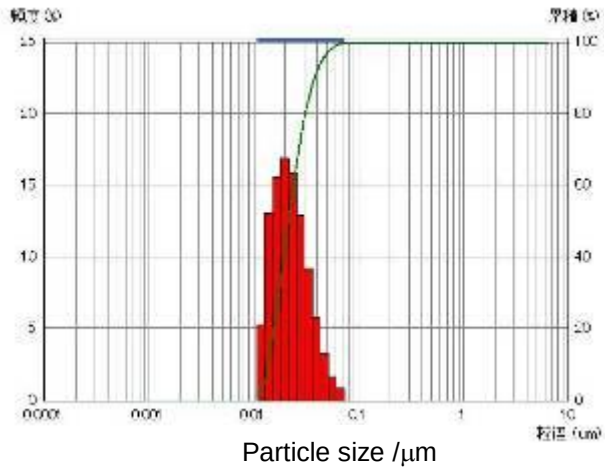
Characteristics of Admanano

- High purity
- Non-aggregation
- Low viscosity
- High transparency

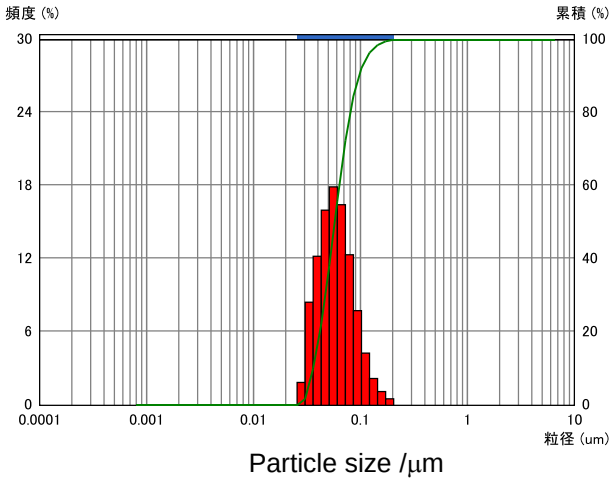
1-2. Various Size Spherical Silica, Alumina

Admanano Silica Line Up

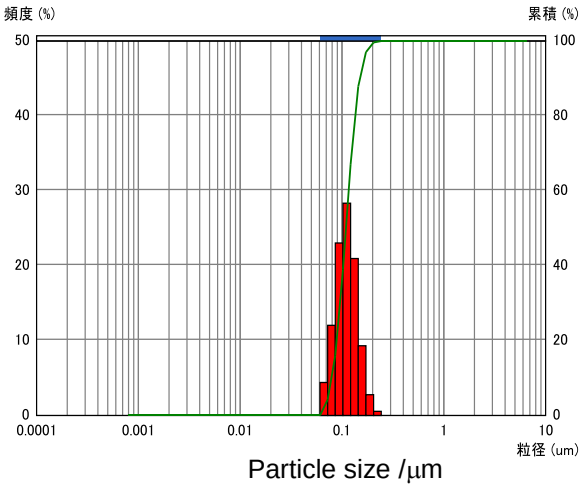
10nm



50nm

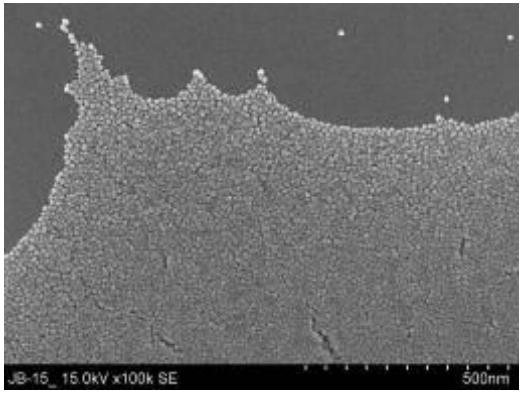


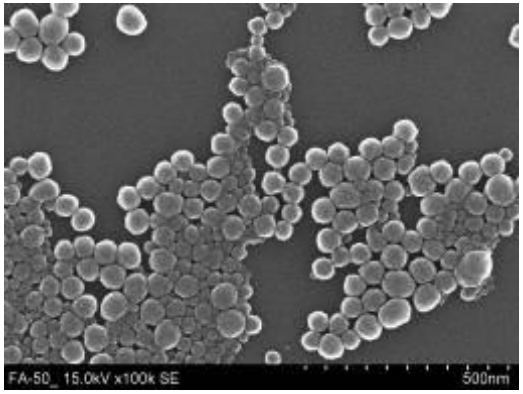
100nm

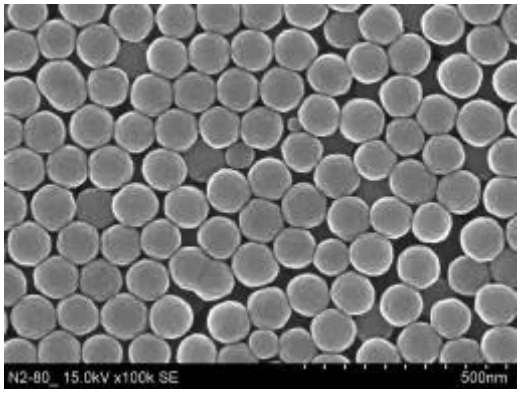


Frequency /%

Accumulation %







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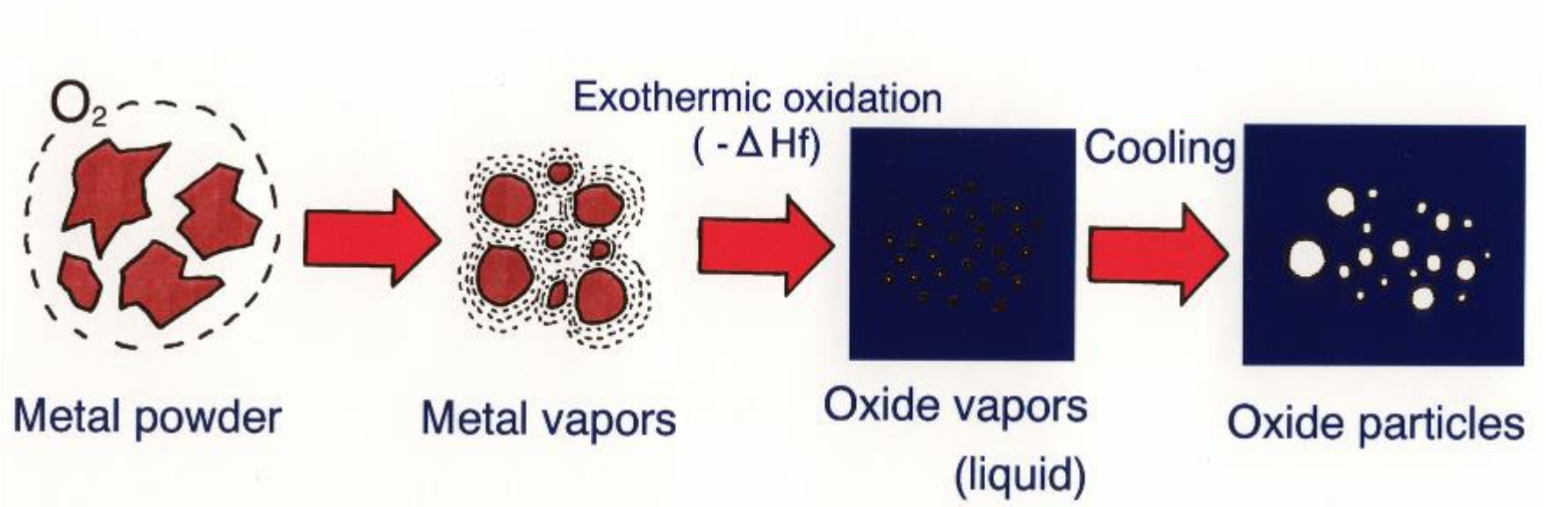
1-2. Various Size Spherical Silica, Alumina

Admafine Manufacturing Process (0.2 – 2um)

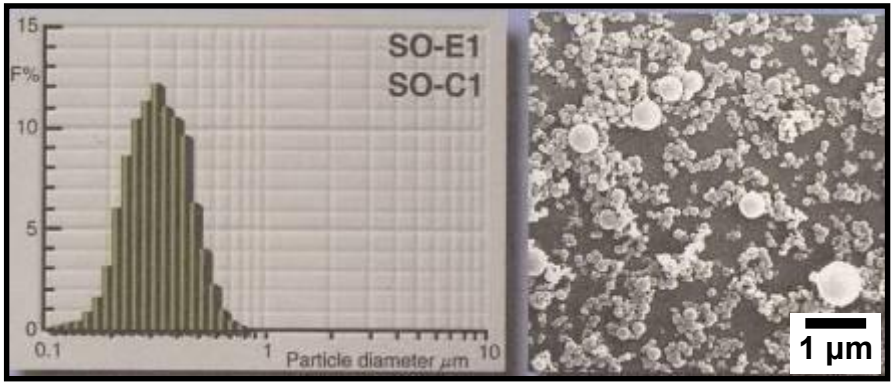
Core technology of ADMATECHS is Vaporized Metal Combustion (VMC) method. The VMC method provides fine spherical silica and alumina particles from metal powder by direct oxidation.



1-2. Various Size Spherical Silica, Alumina

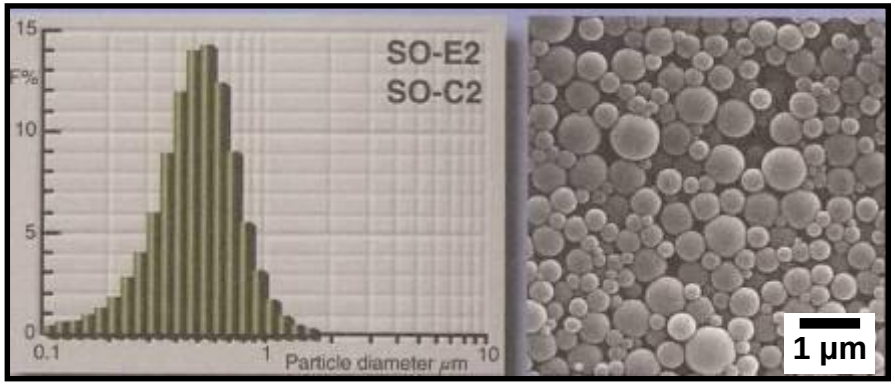
Admafine Silica Product Line Up

Particles size distribution and SEM Images



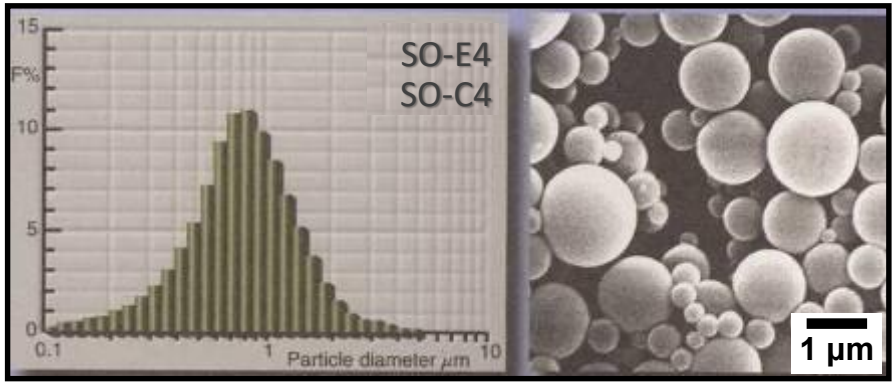
Particle diameter: 0.3 μm

Specific surface area: 10 ~ 20 m^2/g



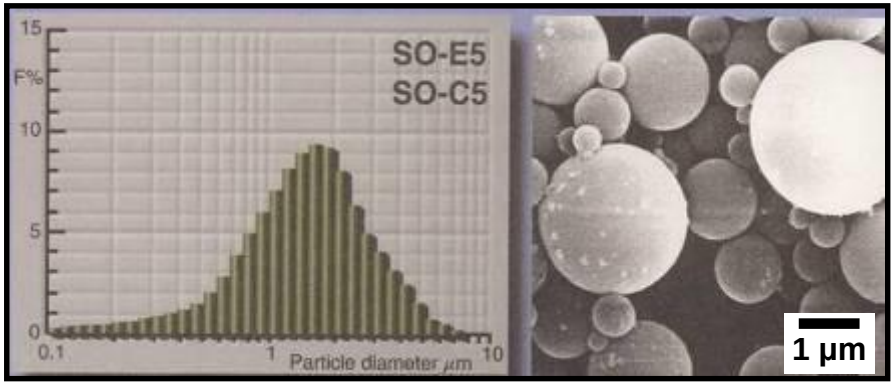
Particle diameter: 0.5 μm

Specific surface area: 5 ~ 9 m^2/g



Particle diameter: 1 μm

Specific surface area: 3 ~ 6 m^2/g



Particle diameter: 1.5 μm

Specific surface area: 2 ~ 5 m^2/g

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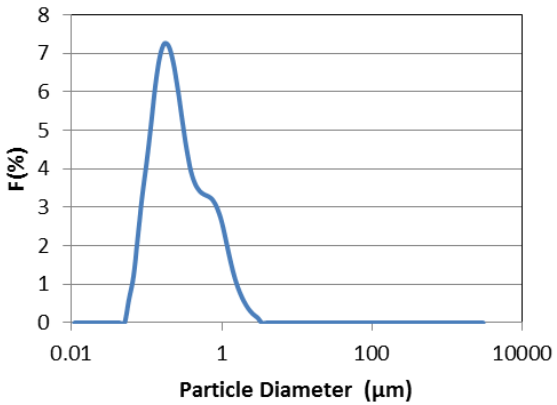
1-2. Various Size Spherical Silica, Alumina
Admafine Alumina Product Line Up

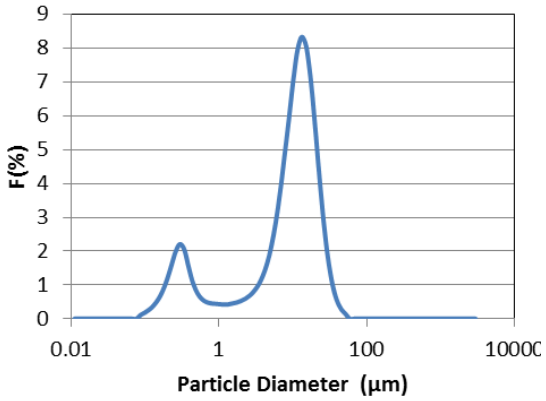
■Particle Size Distribution

AO-502



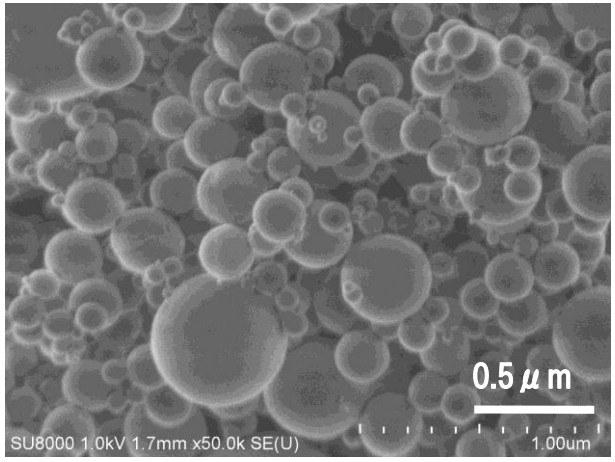
Particle diameter ：0.2 μm

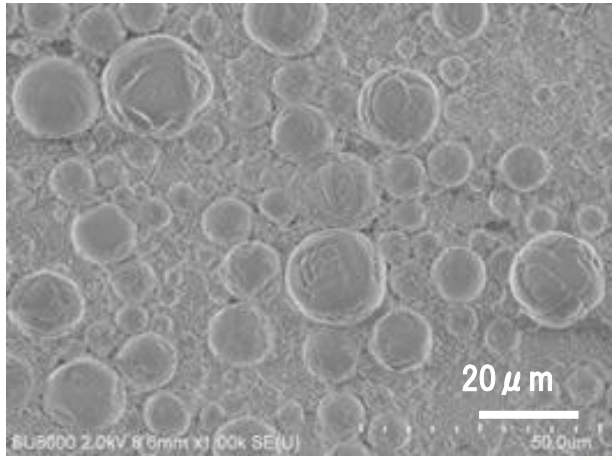
AO-509



Particle diameter ：10 μm

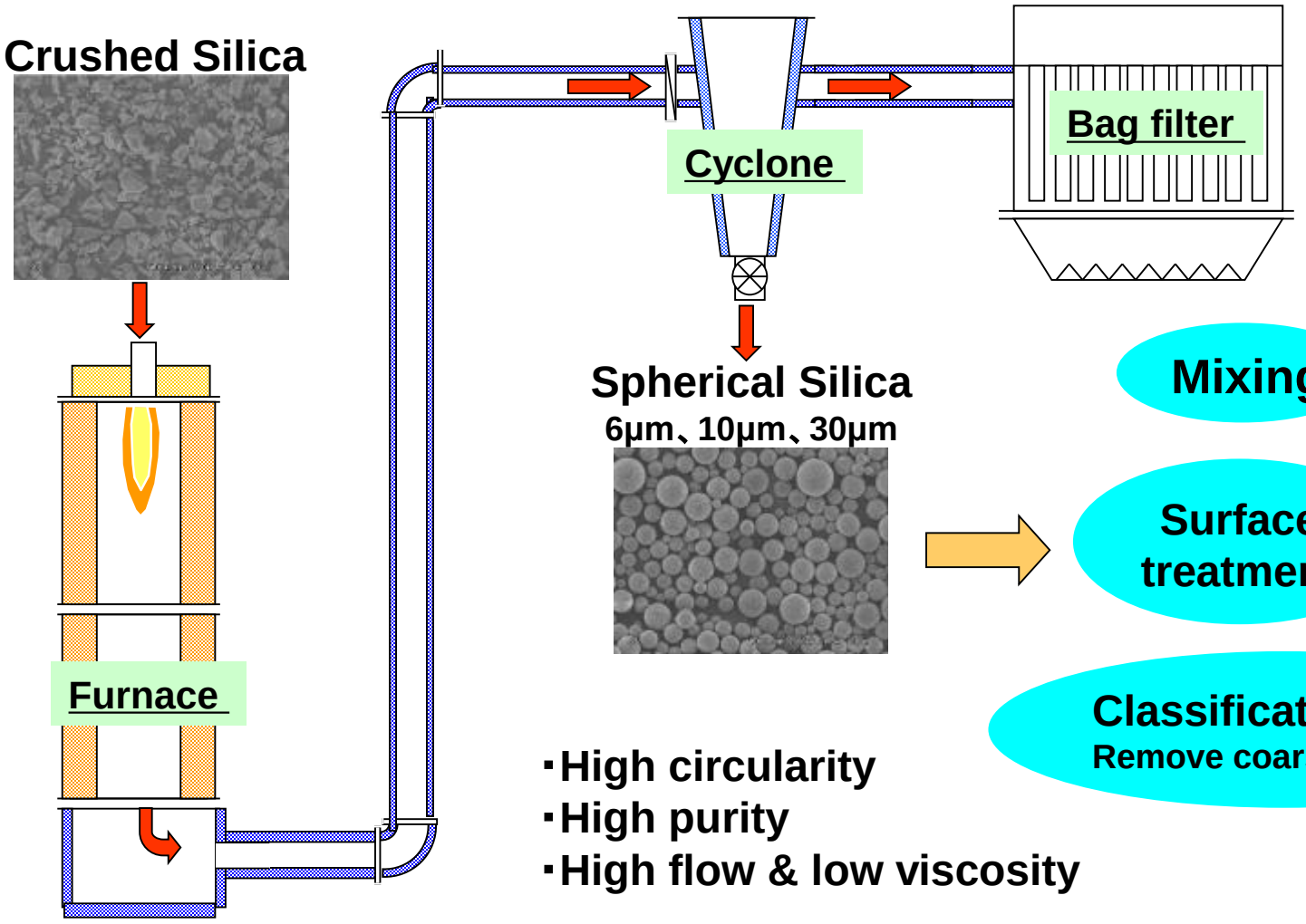
■SEM image





1-2. Various Size Spherical Silica, Alumina

Admafuse Manufacturing Process (5 – 30um)

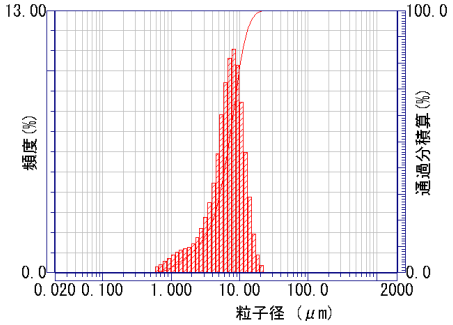
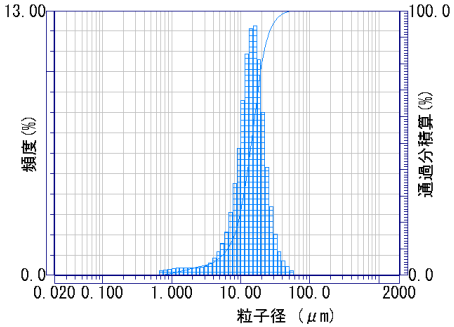
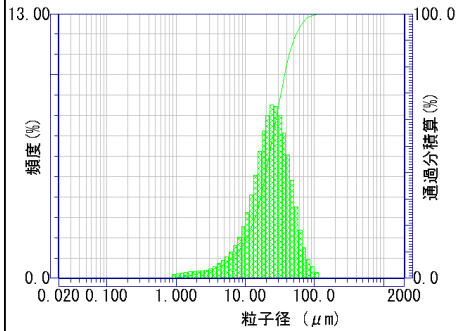
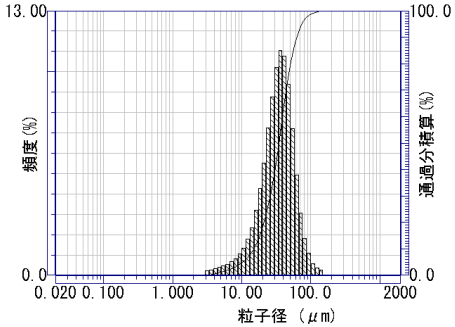
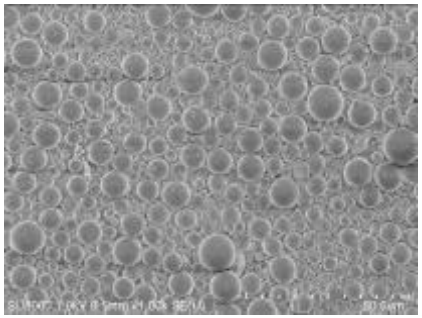
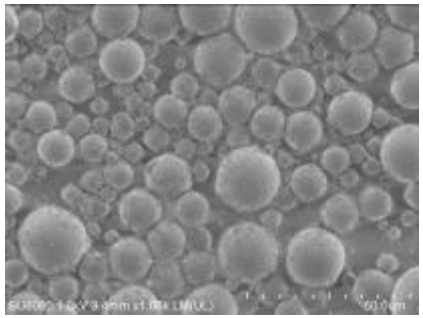
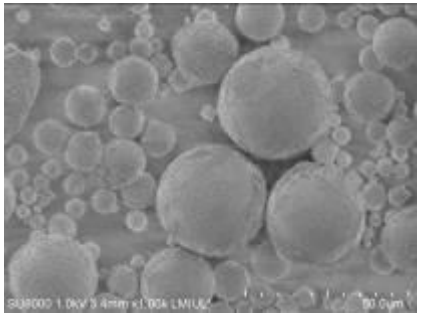
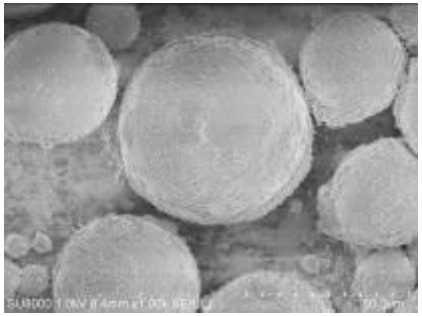


- High circularity
- High purity
- High flow & low viscosity

1-2. Various Size Spherical Silica, Alumina

Admafuse Product Line Up

Product name

FE9-	FEB-	FED-	FEF-
			
5μm	10μm	20μm	30μm
			

1-3. Customize Technology

Surface Treatment Technology, “Layer Concept”.

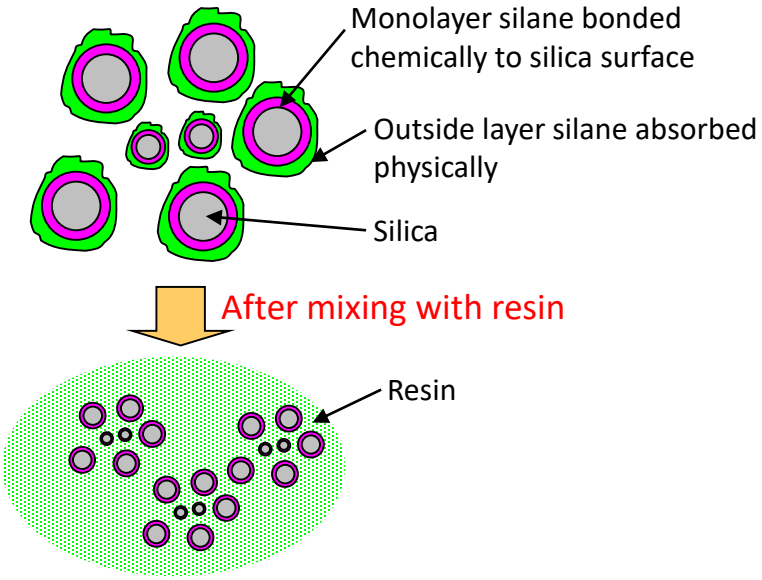
Silica surface modified with silane coupling agent are beneficial for;

(1) Low resin viscosity

(2) Less agglomeration

(3) Better compatibility with epoxy resin

Admatechs Surface Treated Silica

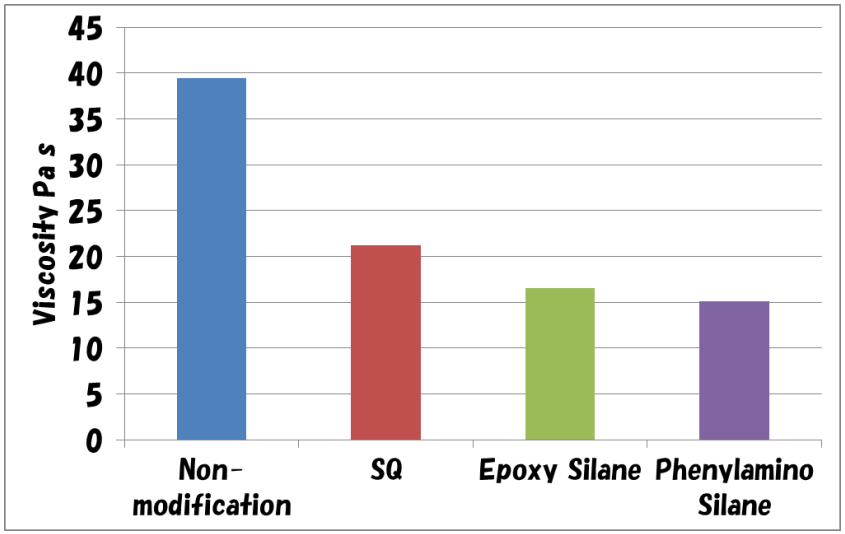


Viscosity Data

Resin : Bis F + Bis A epoxy resin

Silica : 0.5μm silica

Loading : 65wt%



Share rate at 1 (1/sec)

Surface treatment improves the compatibility with resin and reduces the viscosity.

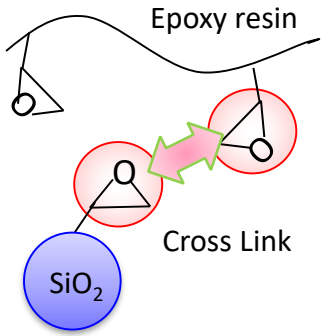
admatechs

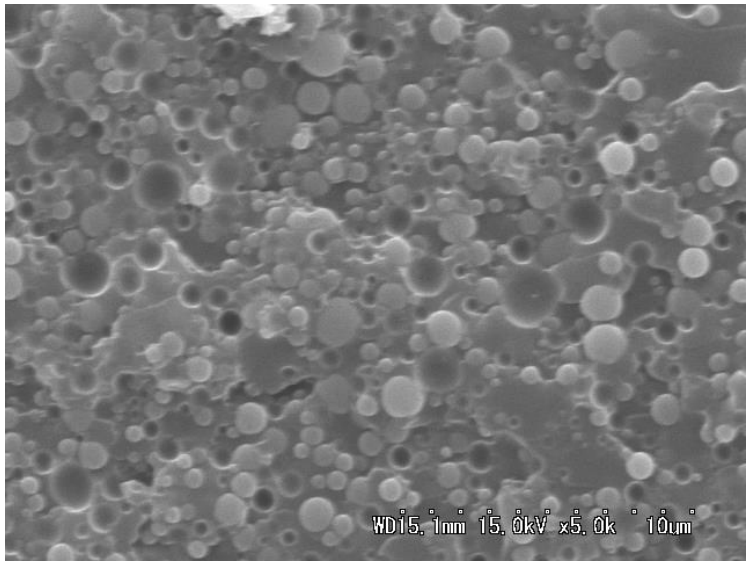
1-3. Customize Technology

Compatibility of Resin Matrix

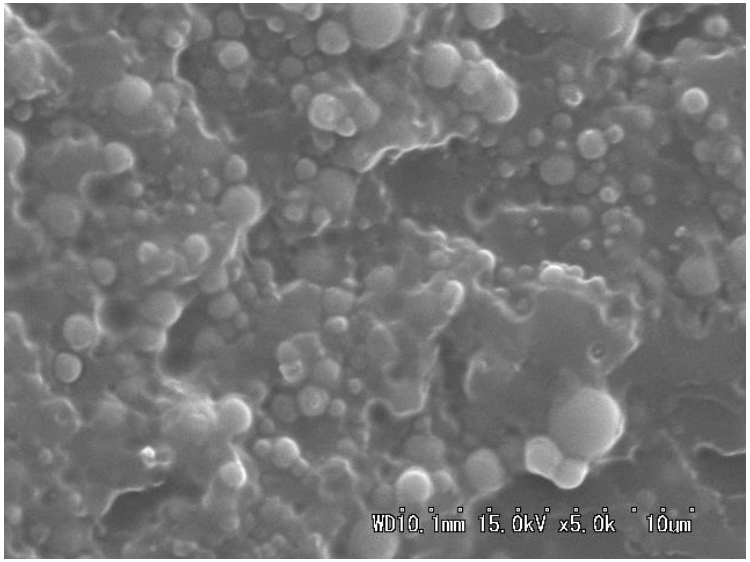
Test Condition

- Silica : 0.5μm silica
- Resin : Bis F + Bis A epoxy resin + Hardener : Imidazole
- Evaluation : Observation of fracture surface after curing by SEM





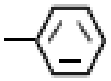
Non-Surface Treated Silica



Surface Treated Silica, (phenyl amino, etc…)

Surface treatment improves the adhesion between silica surface and resin.
This result improves physical properties of compounds.

Example of Surface Treatment Agents

Chemical Structure	Name	Chemical Structure	Name
$(CH_3O)_2Si(CH_3)_2$	Dimethyl silane	$(CH_3O)_3SiC_3H_6OCH_2CH(O)CH_2$	Epoxy silane
$(CH_3O)_3Si(CH_2)_5CH_3$	Hexyl silane	$(CH_3O)_3SiC_3H_6NH$– 	Phenyl amino Silane
$(CH_3O)_3SiC_6H_5$	Phenyl silane	$(CH_3O)_3SiC_3H_6OC(=O)C(CH_3)=CH_2$	Methacryl silane
$(CH_3O)_3SiCH=CH_2$	Vinyl silane	$(C_2H_5O)_3SiC_3H_6N=C=O$	Isocyanate silane

Various surface treatment agents are available.

1-3. Customize Technology

Slurry Technology with Various Organic Solvent

■Characteristics

- High filler loading ～75wt%
- High dispersibility
- Coarse particle free

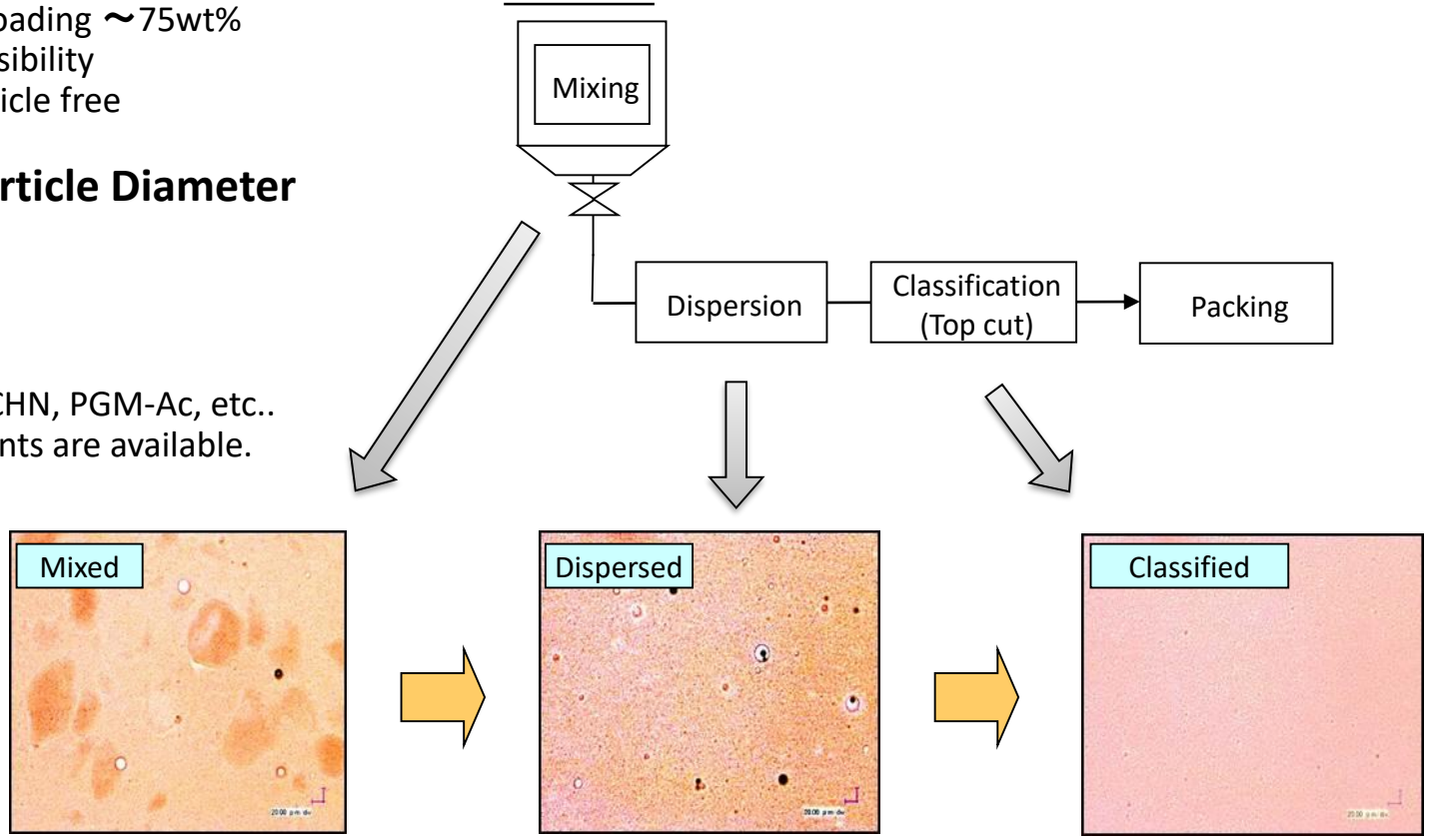
■Silica Particle Diameter

～1.5μm

■Solvent

MEK, MIBK, CHN, PGM-Ac, etc..
Various solvents are available.

Process



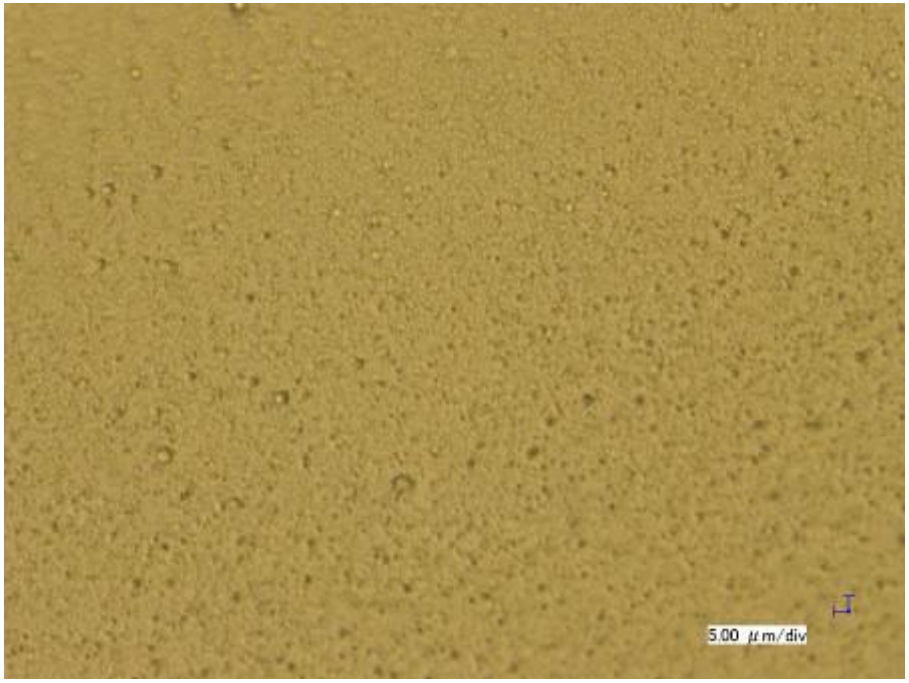
Many agglomerations → Agglomeration free

Coarse particle (≧20μm)

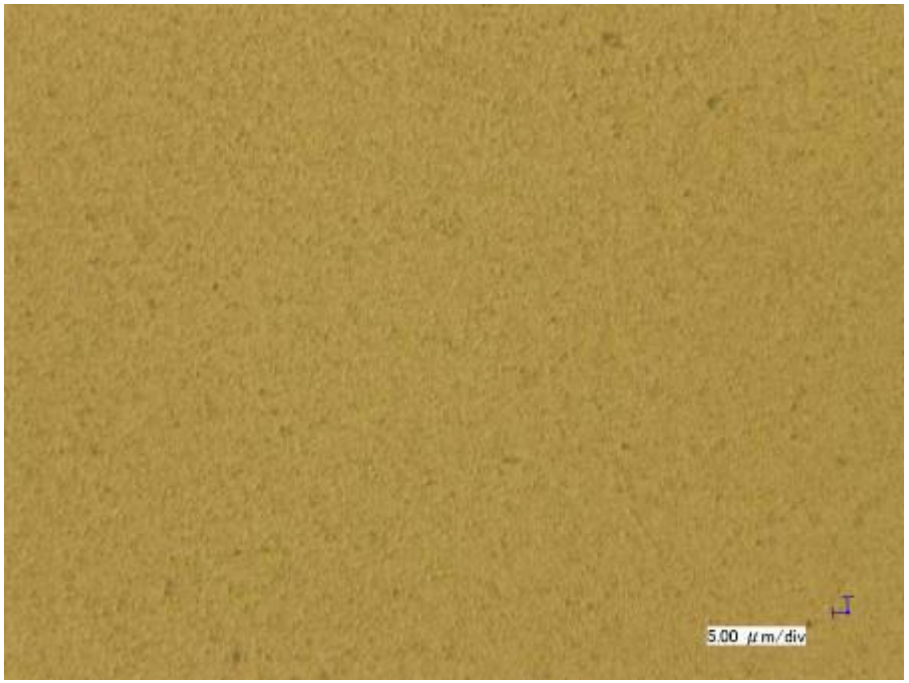
More than million pieces per 100g → Less than 10pcs per 100g

1-3. Customize Technology

New Classification Technology (for Admafine)



at 5μm
（containing 100ppm > 5μm particle）



at 3μm
（containing 10ppm > 3μm）

Photographs of 0.3μm particle size silica slurries（×1000）

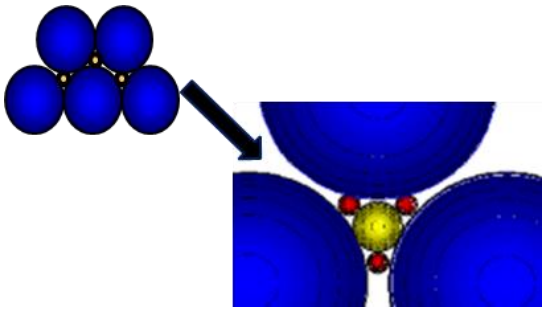
1-3. Customize Technology

Control of Particle Size Distribution

<Closest Packing Concept>

1) Combination of bigger particle and smaller particle

2) Submicron size & Spherical shape



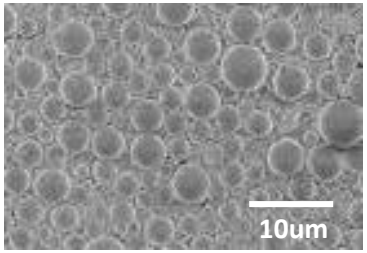
Resin Viscosity

Resin : Liquid Epoxy resin （BisA ＆ BisF mixed）

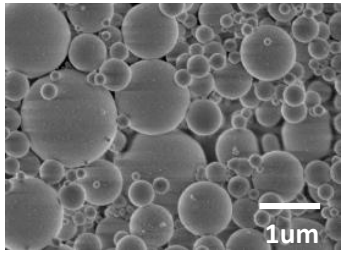
Filler : 5um silica

: 0.5um silica

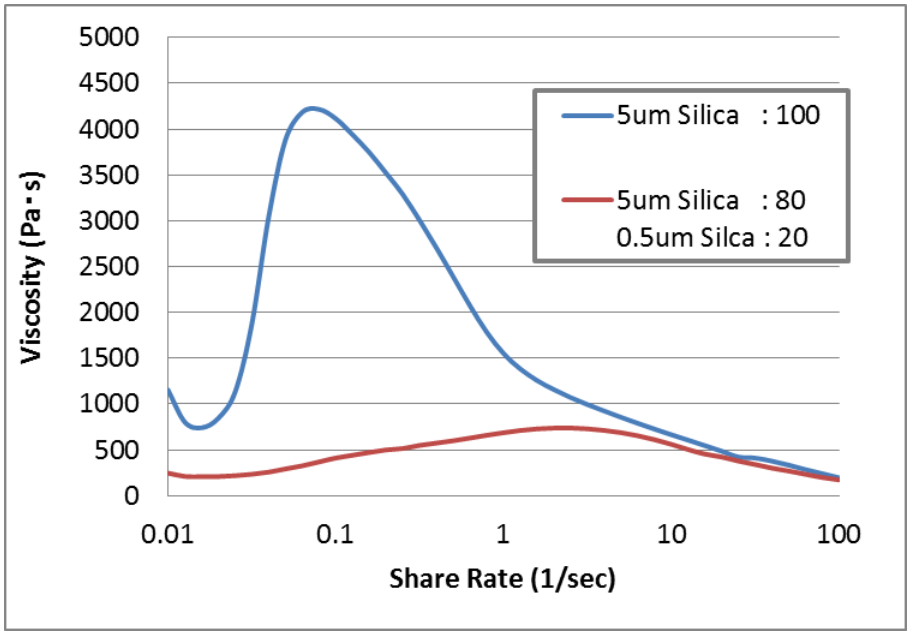
Loading : 80wt%



5um silica



0.5um silica



Closest Packing can improve the compound viscosity.

1-3. Customize Technology

Control of Particle Size Distribution

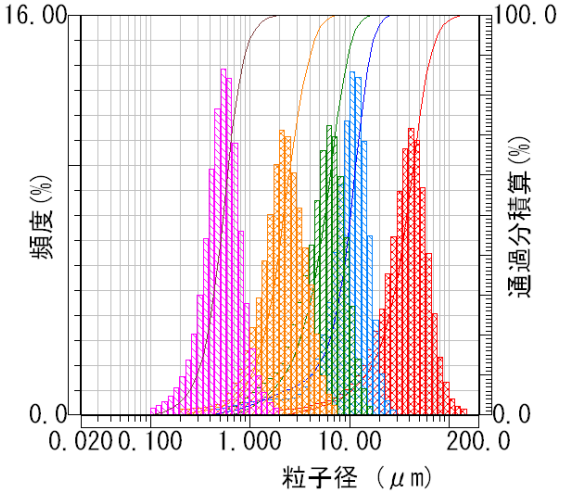
The product can be developed according to customer's demand by Admatechs.

Fused silica (2～30 μm)
Admafine silica (0.2～2 μm)

⇒ Customized silica

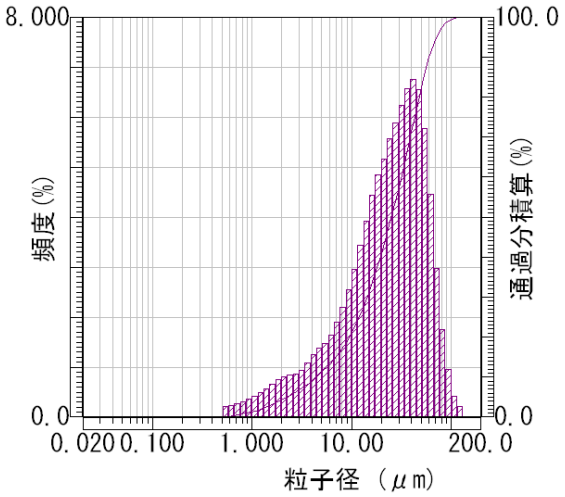
Input: customer's information

- **Particle diameter**
- **SSA**
- **Silica loading**
- **Classification**
  Remove coarse particle
- **Surface treatment**
  (Resin information)



Base silica

⇒



Customized silica

Admanano Silica Line Up

Particle size [nm]	Specific surface area [m^2/g]	Surface treatment
10	300	Methacryl Vinyl Phenyl Phenyl-amino
50	60	
100	30	

Slurry	
Filler loading [wt%]	Solvent
20～30	MEK MIBK CHN PGMAC , etc.
50	
60	

Resin master batch
Resin : Epoxy Acrylic , etc.

*Note: This table includes development grade.

Purity	SiO_2 [%]	Moisture [%]	Na+ [ppm]	Cl- [ppm]	Fe [ppm]	Al [ppm]	U [ppb]	α-ray count [$c/cm^2 \cdot h$]
Regular grade	> 95	< 2	< 10	< 10	< 1000	< 2000	-	-

※Data on this sheet are NOT guaranteed value.

Admafine Silica Line Up

Particle size [μm]	Specific surface area [m^2/g]	Surface treatment	Slurry	
			Max filler loading [wt%]	Solvent
0.3	10-20	Regular(SQ) Epoxy Vinyl Phenyl-amino Methacryl Phenyl , etc.	～65	MEK MIBK CHN PGMAC , etc.
0.5	4-7		～75	
1.0	3-6		75	
1.5	3-5		75	
2.0	1.5-2.5			

*Various cut points are available.

Purity	SiO_2 [%]	Moisture [%]	Na+ [ppm]	Cl- [ppm]	Fe [ppm]	Al [ppm]	U [ppb]	α-ray count [$c/cm^2 \cdot h$]
Regular grade	> 99.8	< 0.05	< 1	< 1	< 500	< 700	11	0.006
High purity grade (Low α-ray)	> 99.9	< 0.05	< 0.5	< 0.5	< 20	< 100	< 0.3	< 0.002

※Data on this sheet are NOT guaranteed value.

Admafine Alumina Line Up

Base Material	Particle Size [µm]	Specific Surface Area [m^2/g]	Top Cut [µm]					Surface Treatment
			75	45	25	15	5	
AO-502	0.2	7.5	○	—	○	—	○	Vinyl Phenyl-amino Methacryl Phenyl , etc.
AO-509	10	1.5	○	○	○	○		

*Note: This table includes development grade.

Purity	Al_2O_3 [%]	Moisture [%]	Na+ [ppm]	Cl- [ppm]	Fe [ppm]	Si [ppm]	U [ppb]	α-ray count [$c/cm^2 \cdot h$]
Regular grade AO-5 Type	> 99.8	< 0.3	< 1	< 2	< 1500	< 500	-	-

*High purity grade is available too.

※Data on this sheet are NOT guaranteed value.

AdmaFuse Silica Line Up

Base Material	Particle size [μm]	Specific surface area [m^2/g]	Top cut [μm]				Surface Treatment
			75	45	25	20	
FE9	~8	~2	○	—	○	○	Epoxy Vinyl Phenyl-amino Methacryl Phenyl , etc.
FEB	~15	~2	○	—	○		
FED	~25	~2	○	—			
FEF	~35	~2	○				

*Note: This table includes development grade.

Purity	SiO_2 [%]	Moisture [%]	Na+ [ppm]	Cl- [ppm]	Fe [ppm]	Al [ppm]	U [ppb]	α-ray count [$c/cm^2 \cdot h$]
High purity grade (Low α-ray)	> 99.9	< 0.1	< 1	< 1	< 300	< 100	< 1	< 0.002

※Data on this sheet are NOT guaranteed value.